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NIGHT ATTACK BY GERMAN ARMORED MOTOR BOATS IN A FLOODED SECTION OF FLANDERS.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Militarism

MUCH of the muddled-headiness which characterizes the discussion of our public affairs is due to a lack of clear definition of terms. When the most important word in a subject of debate means half-a-dozen different things to half-a-dozen different people, there is little hope of arriving at a common and correct conclusion.

How true this is, in its effect upon the question of the military preparedness of the United States! Here we are confronted with the amazing spectacle of the richest republic in the world in such a state of defenselessness that if its territory should be invaded by any one of the leading military nations, the United States would be powerless to offer any effective resistance.

To what is this perilous condition to be charged? To many causes; but mainly to the confusion which has resulted from the constant reiteration, both in Congress and outside of it, of that scarecrow word "militarism," by people who have no clear sense of its true meaning.

Whenever the experts of our army and navy have urged Congress to make reasonable provision for defending our shores from invasion and crushing the enemy should he effect a landing, they have been met by the cry that this is militarism—something opposed to the constitution, traditions, spirit, wishes, etc., etc., of the United States.

Now what is militarism? Militarism does not consist in the mere possession of an army, big or small. The United States, with a population of about one hundred million people, has within its borders some 30,000 troops or one to every 3,330 inhabitants; therefore, to lay a charge of militarism against this country on the ground of the size of its army would be manifestly ridiculous, and judged on the mere question of numbers it is evident that a considerable increase of our military forces could be made without rendering this country liable to such an implication. Nor is the possession of an army sufficient to prevent an enemy from over-running and ravaging the State and levying heavy tolls, militarism. Thus, Switzerland, with only 3,300,000 inhabitants, can put in the field nearly 300,000 trained soldiers; yet no one has ever made a charge of militarism against that country—the fact being recognized that, because of her important strategic situation and the temptation for powerful neighbors to make a short cut across her territory, Switzerland is fully justified in arming her citizens to protect her neutrality.

What, then, is militarism? For an answer to this question, so clear and convincing that he who runs may read, we direct attention to an article in the New York *Times* on January 12th, 1915, by Prof. Frank Jewett Mather, Jr., of Princeton University, who starts his analysis with a quotation from the New English Dictionary, to the effect that militarism is "the political condition characterized by the predominance of the military class in government or administration; the tendency to regard military efficiency as the paramount interest of the State."

This is an exact definition of the essence of militarism, which, according to Prof. Mather, is simply that the military establishment is not subordinate, but superior to the civic power. The issue is merely, who rules—soldier or statesman? England, according to this authority, is no more militaristic to-day with one and one half million men under arms than she was six months ago with only a tithe of that number, and this for the reason that since the passage of the Bill of Rights, Parliament has always controlled the army and navy. France had her era of militarism under the first Napoleon and under the third; and twice since then, in the Boulanger episode and the Dreyfus affair, she moved in a militaristic direction, but promptly and resolutely retraced her steps toward democratic control.

But when, "at every stage of the delicate negotiations" preceding and inaugurating a war "the military rulers dictate the decision of the civil rulers," the predominance of the military class in government is manifest, and militarism in its extreme form is rampant.

"It may be well," says Prof. Mather, "to ask what are the outward symptoms of militarism in a State. The most evident symptom is an unduly privileged position of its army and navy officers. No English captain of a dreadnought, or French colonel of a legion, or Russian general, or American admiral cultivates or is permitted to cultivate a special set of truculent military manners. He claims no social privileges above other gentlemen. In a controversy with a civilian, the clubs and the law courts give him no favored position. The idea that he is privileged to bully or humiliate the most obscure civilian never occurs to him. In unmilitaristic nations the code, written and unwritten, that is binding on any gentleman is equally binding on an officer."

Now if we apply the above incontrovertible definition of militarism to conditions in the United States, it will be recognized by every American who understands the attitude of our army and navy toward the civil authority and toward the civil population, that militarism has never existed in the United States, has never threatened to intrude on our national life, and is the very last calamity that could befall us.

In no country in the world is there a body of naval and military men, from commander-in-chief down to lieutenant, which is so easy of approach and so courteous in its bearing toward the civilian population as that of the United States. Indeed, the loyal recognition of the predominance of the civil authority is one of the unique characteristics of the military situation in our country. Of all things which we have to fear in America, militarism as described above by Prof. Mather, is the very last.

It follows, then, that to brand as militarism the present nation-wide demand that the neglect of the past be made good by increasing our military forces to the modest strength that will give adequate protection against attack of any power, is not only supremely ridiculous, but is in the highest degree unpatriotic. It is to obscure a vital issue by beclouding it with a term that is not merely misleading but is positively vicious in its effect.

Science and Lexicography

"IN learning the meaning of scientific terms, the history of science is our dictionary; the steps of scientific induction are our definitions."

Everybody who writes much on scientific subjects must realize the truth of this aphorism of William Whewell; yet few of us can quite free ourselves from our childhood's faith in the Dictionary as a court of last resort, a tribunal without appeal. The present writer recalls the dismay of one of his scientific acquaintances, who was writing a treatise on meteorology, on learning that he had repeatedly used therein the word "insolation" in a sense not at that time recognized by any dictionary of the English language, i. e., as the equivalent of "solar radiation" or "sunshine." The word hardly ever has any other meaning in meteorological literature; yet the accidental omission of the meteorological definition from all the English dictionaries—an accident to which one might still find thousands of parallels—caused our colleague to consider seriously the advisability of substituting another term in his book. It is true that the author in question had given little thought to terminological questions—but one might say as much of at least ninety-nine scientific men in every hundred.

In view of the immense importance of accurate and consistent terminology as an aid, first, to clear thinking, and, second, to the transmission of knowledge, it is a startling fact that very little attention has been paid either to formulating the principles of scientific terminology or to applying these principles to the task of regulating the scientific vocabulary. One must go back more than half a century, to Whewell's almost forgotten "Novum Organon Renovatum," for a sane and comprehensive treatise on this subject.

A hopeful sign, as far as it goes, is the fact that the editors of all the recent great dictionaries published in America have enlisted the aid of specialists in defining scientific terms. The astronomical definitions are written by an astronomer; the chemical definitions by a chemist; and so on. As a result of this plan, technical terms and the technical senses of general terms have received a far greater measure of recognition in general dictionaries than was ever before accorded them; yet the definitions of these terms are often extremely disappointing. It is, unfortunately, a fallacy to assume that an able astronomer is necessarily better qualified than anybody else to write the definitions of astronomical terms. Undoubtedly the ideal lexicographer of astronomy, if he exists, will be found in the ranks of the astronomers; but he will be the exceptional astronomer whose general scholarship and whose familiarity with the history and the literature of his science specially qualify him for lexicographical undertakings. His work in this direction will be, more or less, that of a pioneer; he will find the vocabulary of his science, as used by astronomers themselves, in a state of great confusion; he must know thoroughly the astronomical literature of other languages than his own, since in no language—not even German—is the vocabulary of science free from foreign influences; in short, his scholarship will be taxed to the utmost to ascertain the consensus of usage among his own colleagues, as a preliminary to presenting the definitions of astronomical terms to the public at large. So, *a fortiori*, of many other sciences.

The lexicographer of science should, we believe, be a lexicographer first and a scientist second; but he must be both. Until persons possessing this dual training are more numerous than they are at present, our general dictionaries will continue to be more or less at sea in their scientific definitions—often grotesquely so.

The Cost of Health-seeking

A "CHANGE of climate" is apt to be looked upon as a panacea for the ills of the flesh, but one that is often difficult or impossible of realization for financial reasons. Nevertheless, we daily hear of cases in which families have achieved the impossible, by dint of heroic labor and sacrifice, in sending invalid members to health resorts to which distance lends the enchantment of hope—sometimes destined to prove altogether illusory. Whether or not the longed-for cure is ultimately effected, climatic treatment is, in the average case, so expensive that its implications should be thoroughly understood by the invalid and his friends before he leaves home, and it is obviously desirable that all physicians should be able to enlighten their patients on this subject.

Dr. Thompson Frazer of Asheville has contributed to the U. S. Public Health Reports a paper entitled "Tuberculosis; the Financial Aspect of the Sick Leaving Home in Search of a Beneficial Climate," in which he calls attention to the fact that tuberculous patients too often fail to realize the futility of visiting a health resort unless provided with sufficient funds to insure suitable living conditions while there and a stay long enough to be beneficial. He says, "A large proportion of people, including the medical profession, seem to be uninformed on this most important phase of the tuberculosis situation"; and he gives some valuable figures as the fruit of his own experience and observation at the well-known North Carolina resort.

As everybody knows, "tuberculosis is the disease of the many, not of the favored few," the vast majority of the sufferers being those who live from hand to mouth and who can so ill afford a suspension of their daily labor that the disease usually reaches an advanced stage—demanding a correspondingly long period of treatment—before they seek a cure that entails inactivity. It is, too, pre-eminently a disease of the earlier years of productive life, with a maximum mortality between the ages of 20 and 30, i. e., it strikes down the wage-earner who has not yet had time to make much, if any, provision for such an emergency.

In estimating the expense of treatment at a health resort several facts are commonly overlooked. In the first place, a short stay is generally useless. Many patients arrive at Asheville nearly insolvent, expecting to be cured in a few weeks, when at least ten months may be requisite. In such cases the money spent in traveling expenses could be used to much better advantage in home treatment. Again, climate is, according to Dr. Frazer, the least important of all the factors that make for improvement in tuberculosis, "and unless supported by the essentials—fresh air, good food, proper care—the most perfect climate must prove valueless." Good food and care are expensive. Economy in these essentials may defeat the object of the visit. Thus, while it may be possible to get a room on the third floor of an Asheville boarding-house, with board, for $8 a week, while a first-floor room costs $10 or $12, the exertion of climbing stairs may be more than the patient can safely undertake. There are various "extras" of which the patient perhaps knows nothing until his arrival. A minimum expense of $700 for a ten months' stay is a fair estimate for Asheville.

In view of the number of people to whom such an expense is either absolutely prohibitive or certain to be a crushing burden upon their families, Dr. Frazer's figures appear to be a powerful argument for a national scheme of health insurance even more far-reaching than that with which Great Britain is now experimenting.

Electricity

A National Electric Week.—At a recent meeting of the representatives of leading electrical manufacturers, central stations, jobbers, contractors, dealers and trade journals, plans were laid for a great national week to be held sometime next fall in the United States and Canada. It is hoped to arouse a great interest in matters electrical, stirring up the public on questions of better lighting for streets, stores, factories, schools and homes and promoting the sale of electrical appliances.

A Dwarf Telephone.—At a recent meeting of the Royal Society, London, Dr. P. de Lange, of Utrecht, exhibited a telephone in the form of a small cylinder of about the diameter of a pencil and half an inch long. A very fine wire of platinum is variably heated by the passage of talking currents through it, producing expansions and contractions of the surrounding air and hence throwing out corresponding sound waves. The receiver is small enough to be inserted in the ear and acts as a seal to exclude extraneous noises.

Electricity v. Steam in Railroad Practice.—According to the *Electrical World*, a New Haven Railroad official is quoted as saying: "Upkeep of electric engines is on the order of 5 cents to 7 cents per locomotive mile per 100 tons of weight. Steam-locomotive maintenance runs anywhere from 8 cents to 25 cents, depending upon nature of the coal and water used—an average figure of 11 cents would not be bad. With regard to pounds of coal burned for electric-engine v. steam-engine haul, a pound of coal burned under the boilers of a central electric station for such traffic will develop twice the drawbar pull that would be developed if the same pound of coal was burned in the firebox of the steam locomotive."

Spark Gap Electrodes.—In order to determine the effect of certain metals on electric sparks, Prof. Daniel M. Rich, of the University of Michigan, has been conducting some very interesting experiments. He has found, by photographic records, that on producing a spark with an alternating current, between a copper electrode and a zinc electrode, a certain number of sparks were given off from the copper electrode, during one half cycle, while in the following half cycle, when the current was reversed, more sparks were given off from the zinc electrode. Prof. Rich believes that the cause of this is that the potential must reach a higher value before it will jump from the copper. Very curiously there was always an even number of sparks from one electrode and an odd number from the other, also the last spark always occurred from the electrode having the higher breakdown value. This surprising effect may be due to the ionizing of the arc, Prof. Rich believes.

Increasing Self-induction in Cables.—It is well known that the carrying power of a telephone cable for underground or submarine use is much smaller than that of an overhead line; in other words, a less distance can be covered with clear sound of the voice than for overhead lines, this being due to the preponderance of the capacity of the cable over the self-induction, and the sound of the voice is altered or deadened. An increase in the section of the cable would be expensive, so that other means have been sought in order to reduce the damping effect by an artificial increase in the self-induction. The Danish engineer Krarup makes use of a very successful method which consists in increasing the magnetic permeability in the neighborhood of the conductor by wrapping it about with a very fine soft iron wire, and this has the effect of increasing the self-induction considerably. In this way the carrying power of a cable is generally doubled by the use of the Krarup method. To obtain the same result without the iron wire wrapping, or by simply increasing the section of the copper, four times the section is needed. The Krarup method is a rival of the well-known Pupin system for obtaining the same results.

French Interurban Network.—The extensive interurban network of electric power lines in the region of Nancy is of interest not only from a technical standpoint but also from the fact that this part of France lies in the scene of the present war operations. The large town of Nancy is in fact situated not 15 miles from the frontier of Lorraine. An operating company already assured the electric service for the city, and more recently decided to lay out an important interurban system for covering the region lying to the east, south and west of this center. Power comes in part from the city station, but there is a second steam plant building, and it will be situated on the Moselle near Vincey in the Vosges region. Current used is 3-phase at a frequency of 50 cycles, and tension of the interurban network is 65,000 volts standard. At present the output of the city station is about 20,000 kilowatts, while the Vincey plant is to furnish 15,000 kilowatts during the first period of operation and will then be increased to 45,000 kilowatts in the second period. Current coming from the central plants at 11,000 volts over power lines is received in four transformer posts placed at various points in the region, and from these points start the high tension 65,000-volt lines of the network.

Science

A Geological Survey of Panama is in progress under the joint auspices of the Isthmian Canal Commission, the U. S. Geological Survey, and the Smithsonian Institution. The plan includes a systematic study of the physiography, stratigraphy and structural geology, geologic history, geologic correlation, mineral resources (including coal, oil, and other fields), petrography, and paleontology of the Canal Zone, and as much of the adjacent areas of the Isthmian region as it may be feasible to explore.

Moles are generally regarded as agricultural pests in this country, and it is therefore interesting to learn that farmers may turn a curse into a blessing by trapping these animals for their skins. At present the moleskins used for making fur garments in the United States are nearly all imported from Europe. The Biological Survey reports that the skin of the common mole of the eastern United States is actually superior to the foreign product. Whether this is also true of the larger species inhabiting the northwestern coast region is the subject of investigations now in progress. The last species is very abundant, as many as a hundred individuals to the acre being found in some localities.

Mercury as a Plant Germicide.—A new method of destroying plant and household pests and for fungus diseases has been devised by Mr. Franz X. Bickel of Kufstein in the Tyrol, according to a recent number of the *Chemiker-Zeitung*. In inclosed spaces the mercury is employed in the form of vapor. In other cases it is injected in metallic form directly into the circulating fluids of the plant. The growth of the plant is not only not disturbed, but is in most cases actually assisted. When a tree is treated the process is as follows: With a stout 3-millimeter auger holes are bored in the lower branches—from 5 to 7—in an oblique direction and passing through the pith. These holes are then filled with mercury by means of an ordinary "dropper," after which they are made air-tight with "tree-wax" or some similar substance. From 2 to 7 grammes of mercury are required for an inoculation. The effect is quickly observable and continues for a year or more.

The Phytopathological Observatory at Turin, Italy, has just been reorganized, and it therefore seems timely to call attention to this useful institution, which is one of the prominent agencies in the world-wide campaign now being waged against the spread of plant diseases. The observatory was founded in 1908, replacing a phytopathological laboratory established in 1905. According to a royal decree of last May the observatory is now charged with the tasks of (1) following carefully any condition of disease in cultivated plants and studying its causes and remedies; (2) spreading information concerning plant diseases and their treatment among farmers; (3) co-operating with farmers in actual work of suppressing such diseases; (4) phytopathological work in the public parks and avenues of Turin; (5) examination of doubtful mushrooms and other fungi; (6) maintaining a museum of plant pathology; (7) seed inspection; (8) keeping watch for new plant diseases and taking measures to control them throughout Piedmont.

Smut Fires in Threshing Separators.—A remarkable series of mysterious and disastrous fires, or so-called explosions, occurred in threshing separators in the great wheat-growing region of eastern Washington last summer. These increased in frequency as the threshing season got under way, until it was no uncommon thing to hear of six or eight fires a day, the total number during the season amounting to at least 300. As each fire necessitated the immediate purchase of a new separator, at a cost of from $1,200 to $1,500, the total loss was very serious, probably half a million dollars, including incidental damages. The fires usually appeared to originate at or just back of the cylinder of the separator, and within two or three seconds the entire separator would be a mass of flames, so hot that it prevented the approach of workmen and very soon destroyed the machine, besides spreading in most cases to the straw pile, the threshed grain, and even the unthreshed grain in the surrounding fields. In several cases workmen were seriously injured by these explosive fires. Although fires in separators had not been previously unknown, they had rarely numbered more than a dozen in a season in the whole wheat region of Washington, Oregon and Idaho; hence the fires of last summer were altogether anomalous, and were widely ascribed to incendiarism. A thorough investigation of the matter was made by experts from the State College of Washington, and its results have just been published. The fires were undoubtedly due to smut, which is exceedingly inflammable. The amount of smut in wheat during the season in question was much above that of previous years. Moreover, the season was remarkably dry; hence the grain and straw had a low content of moisture and was very friable, besides which an unusual amount of static electricity was developed by the cylinders and other parts of the machinery. The report (Bulletin 117 of the Washington Agricultural Experiment Station) suggests various precautions to be taken against such disasters in the future.

Aeronautics

Aerial Mail Service.—Somewhat less space is devoted to this subject in the current annual report of the Postmaster-General than in the report of last year, but it is stated that during the past fiscal year permission was given in eight instances for experimental aerial mail service. An item of $50,000 has been included in the estimates for 1916 for experimental service in this line.

Accidents to War Aviators.—An interesting statement is that made by a French publication that the number of deaths of aviators in the war service by accident was very small as compared with the records in time of peace; and the explanation is made that in this service only the most skilled men are engaged, and moreover they do not indulge in the sensational exhibition stunts that have brought disaster to many. It may be noted that it is this same sensational exhibition business that has given the general public many erroneous and misleading ideas about flying machines that will sooner or later prove an injury to aviation.

Army Aviator Perishes.—A report from Los Angeles, dated December 21st, tells of a misfortune that overtook two U. S. army officers and resulted in the drowning of one of them. Six machines carrying pilots and observers left San Diego for Los Angeles to compete for the Mackay trophy, scouting for troops on the march near San Diego. The Curtiss aeroplane, driven by Capt. Mueller and carrying Lieut. Gerstner as observer, struck a heavy gale at Ocean Side which forced it far out over the ocean. Although carrying a motor capable of driving at the rate of 75 miles an hour, the Curtiss was dashed into the ocean. Lieut. Gerstner was caught in the upright wires of the machine and carried down to his death. Capt. Mueller clung to the aeroplane, though often drawn under water, and was finally hauled aboard a rowboat by Capt. William L. Patterson, observer on a Burgess tractor, who, with his pilot, Lieut. T. D. Milling, had landed near Ocean Side.

Gunning for the Air-man.—The *Echo de Paris* reports an interview with one of the military aviators in which he tells an interesting story of his experience with the sharpshooters of the enemy: "Generally speaking," he said, "when we fly over the enemy's line we run fewer risks than a sharpshooter who leaves his trenches. However, our job has become somewhat more dangerous during the last weeks, for the Germans, whether it be that their shooting has improved or that they now possess a new aeroplane gun, are firing shrapnel which bursts at a height of 2,300 meters. In the early days their shells were ineffective beyond 1,800 meters. Now, at 2,300 meters we are too high to see clearly, so if we want to bring in any useful information we must descend into the zone of fire. Even then our risks do not appear to be very serious, for a day or two ago I found on landing that my machine had been struck by no fewer than fifteen projectiles, but neither I nor my observer were a penny the worse for it."

Russia has Many Aeroplanes.—A French authority, who is in touch with the subject, states that, while there are not many private aviators in Russia the military authorities of that country have within the last two years trained a very large number of men, and as a result have many more skilled aviators in its service than any other nation. It is also stated that the number has been greatly increased since the war began.

"One talks and reads of the heroic age and how the world has degenerated. But, indeed, this is the heroic age suddenly come again. No legendary feats of the past, no battle with dragons or monstrous beasts, no quest or feat that man has hitherto attempted, can compare with this adventure—this urgently necessary adventure—in terror, danger, and splendor."

Of course one great difficulty stands in the way, and that is the expense, for it is well known that the expenses of taking a title in England are so great as to make it impossible except for a very rich man—and aviators are not of such. But Mr. Wells meets this difficulty with the suggestion: "Is it not a time when honors may again become honorable?"

Aeroplanes for Postal Service.—At a recent dinner in New York the Second Assistant Postmaster General stated that the United States Post Office Department was considering, and desired to establish postal service by aeroplanes. The district in which this means of carrying the mails would be of special value would be in the Rocky Mountain region, where some towns only a short distance apart by the air line now require a trip of some hundreds of miles by the only available surface routes. Another feature wherein aeroplane service has advantages over other methods is that the going is as good in winter as in summer, a fact that holds good in any part of the country; and the present-day aeroplane can be operated in any but the most boisterous weather. Another consideration would be that in time of war the government would have a large body of splendidly trained men to draw from in the postal aviators, and these men would be not only skilled in handling their machines, but would also have a knowledge of the geography of this country, if their services were needed in home territory.

Steamship Terminal in the Bronx

Docking Facilities for Freighters Reaching New York by Way of Long Island Sound. Engineering Difficulties Involved in Damming a Vast Sea of Mud

Pile-driver for driving batter piles.

Capping the bulkhead piles.

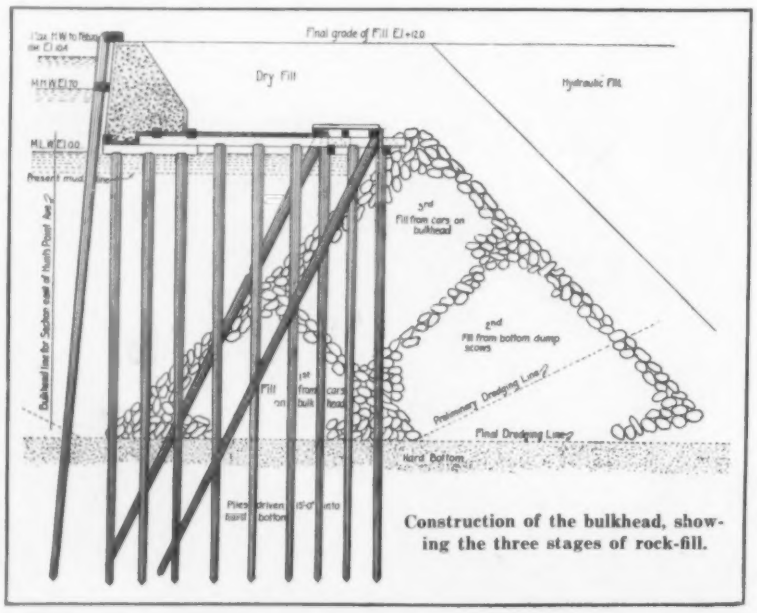
Composite view illustrating various steps in the building of the bulkhead.

WERE it not for the menace of Hell Gate, Long Island Sound would long since have become a favored highway for transatlantic as well as coastwise shipping to and from New York. It forms a wonderful harbor, with plenty of deep water for swift navigation, and with its mouth a hundred miles nearer European ports than that of lower New York harbor. Yet steamers from abroad, and even from our own coast, pass by the mouth of the sound, ignoring its sheltered waters, because, before the main docks of New York could be reached, they would have to thread their way through a difficult channel where the East River is almost strangled by Ward's Island. Although the treacherous rocks at this point were long since blasted away, conflicting tides produce cross currents that make navigation well-nigh impossible for large unwieldy vessels.

It is idle to dream of bettering conditions there. Not without dislodging Ward's Island itself from the throat of the East River would it be possible for transatlantic vessels to enter New York freely by way of Long Island Sound. Even were such a thing possible it would hardly be advisable to crowd the East River with any more traffic than it now carries. The only thing to do is to provide docking facilities above the obstructed point. It must be apparent that the natural outlet for further development of shipping in New York is to be found along the shores of the Bronx; for here railroad connection can be had readily with the network of New England lines, and also with lines running through New York State and to the West, while the connecting railroad which is now being built over Hell Gate to connect New England with Long Island, and then, by tunnel under the East and North Rivers, with lines running south and west, makes this a strategic point for freight traffic with every part of the country.

Hitherto developments in the Bronx have been retarded by an unfavorable shore line, consisting of a vaguely defined region of salt marshes, with a vast and deep mudbank stretching out for hundreds of feet to the channel. Now, however, despite the engineering difficulties presented by the mud, work is under way to provide a large terminal at Hunt's Point. This is just above Hell Gate, and close to the imaginary line dividing the East River from Long Island Sound. The accompanying map indicates the position of the point with respect to Manhattan Island, and the property acquired by the terminal company is delineated in the enlarged map of the region.

Hunt's Point proper is a rocky projection reaching out well toward the channel. On either side of it and also from the Point itself, the mud stretches out toward the channel with a very gradual gradient. Two bulkheads are being built, one at each side of the Point, well within the pierhead line, and dikes of rocks are being laid from the ends of these bulkheads along the boundaries of the property back to the mainland. The entire property will be filled up to a level of about twelve feet above mean low water, while the mud between the bulkheads and the channel is to be dredged out.


Final grade of Fill El+12.0
Dry Fill
Hydraulic Fill
M.H.W. El 10.0
M.L.W. El 0.0
Present mud line
Bulkhead line for Section east of Hunt's Point Ave.
2nd Fill from cars on bulkhead
2nd Fill from bottom dump scows
Preliminary Dredging Line?
Final Dredging Line?
Hard Bottom
Piles driven to hard bottom

Construction of the bulkhead, showing the three stages of rock-fill.

It is no simple task to confine a large and deep body of mud of such fluid consistency as is encountered at this point. The construction of the bulkheads called for a special method, which is illustrated in our wash drawing and also in one of the line drawings. First a preliminary channel was dredged along the line of the bulkhead down to hard bottom. This involved the removal of an enormous amount of mud owing to the flat angle of repose of the thin fluid mud. So fluid was the mud that it could not be removed with the ordinary bucket dredge, but had to be excavated with a hydraulic dredge. Inland, the marshy meadows were inclosed with dikes made of sod and surface material, and within these confining dikes the mud was deposited by a hydraulic dredge. On the east side of the Point the mud varies from twenty to forty-five feet below low water, and on the west as much as sixty-five feet in some places. Curiously enough, after the mud had been dredged out, the hard bottom proved to be at a higher elevation than before; that is, if a sounding had shown a depth of forty feet, after the excavation it was found to be thirty-seven feet. This curious condition was due to the boulders which apparently were actually floating in the mud. As they were not removed by the hydraulic dredge, they collected in a layer on the bottom.

After the preliminary channel had been dredged, piles were driven into the hard bottom through these boulders. The piles were driven in rows of ten with a pair of batter piles to each row to take the thrust of the fill back of the bulkheads. The batter piles were driven by means of a pile driver with swinging leads. A photograph of this pile driver is reproduced herewith. Owing to the layer of rock on the bottom, the piles presented a very disordered jumble at the top. They had to be marked and sorted out to bring them into proper alignment to be capped.

After they had been capped rock was deposited about them in the position indicated in our drawing. The rock was deposited in three piles, the first pile being dumped from cars running on the bulkheads. After this had settled a second pile was deposited from bottom-dump scows and allowed to settle to hard bottom. Finally, the third pile was dumped from cars on the bulkheads, filling the space between the first and second piles and reaching to the top of the bulkheads.

At the present writing the work on the east bulkhead has been completed up to the point of building the concrete quay-wall on the deck carried by the piles. Barges of city refuse are being towed in behind the bulkhead and the material is being deposited upon the rock fill to seal up all the crevices through which the mud might filter. After the dry fill has been completed mud will be excavated from before the bulkheads and deposited behind them, until the level has been raised to the final grade indicated on the drawing.

The work on the dikes stretching from the land out to the bulkheads, along the margins of the company's property is rather interesting. Trestles were built by driving piles down to hard bottom, and, on these trestles cars of rock excavated from the new subway work in the vicinity, were run out and dumped into the mud. At first the rock would be held in suspension in the mud, but as more was added, it would eventually sink to the bottom. In doing so, however, it produced mud waves which were constantly wrecking the trestle.

Frequently a large part of the trestle would disappear with the pile of rock that had been dumped from it. As the rock settled to the bottom there would be subsidence in the surface of the mud at that point which would be compensated by an elevation at some other point. The action was very similar to that of a wave of water, but infinitely slower. As the mud was pushed up by the rock that displaced it, it would curl over slowly like a breaker. One of our photographs shows this interesting phenomenon. All that could be done was to continue depositing new material and rebuilding the trestle until eventually a pile of rock was established from the solid bottom below to a level above that of the surrounding mud-flats.

The bulkheads are well within the pierhead line. On the east side there will be room enough to build piers a thousand feet long. The channel provides a depth of thirty feet below mean low water, so that large vessels may be accommodated. The terminal should not only attract new traffic through Long Island Sound, but should divert to itself much of the shipping that now is obliged to pass on down the narrow congested East River. It should do much for the development of the upper part of greater New York, which is the logical outlet for further expansion of this great city. We are indebted to the Foundation Company which is building the bulkheads for the photographs here reproduced.

A mud-wave slowly curling over like a breaker.

Sod dike for retaining the hydraulic fill.

American Samoa

THE Navy Department has recently published a pamphlet entitled "American Samoa; General Report of the Governor," which constitutes a unique reference-book concerning this small and heretofore little-known American possession in the South Seas. The author is Commander W. M. Crose, U. S. N., who formerly occupied the triple post of governor of the colony, commandant of the Tutuila Naval Station, and commander of the station ship. The report comprises a history of the islands; a description of their physical geography, flora, and fauna; a summary of the laws and other political features; and general statistics. Among the more novel and striking facts set forth in this publication are the following:

The islands have no regular laws, but are subject to "regulations" issued by the governor. The political status of the islands and their inhabitants is peculiar. Although, after much diplomatic see-sawing, England and Germany renounced all claim to the portion of the Samoan group now constituting American Samoa, and the rest of the group is now a German crown colony (or was, prior to the recent raids by Australian cruisers), the United States did not, by virtue of the international agreement, acquire sovereignty over the islands, the independence of which had previously been recognized by the three powers. The chiefs of Tutuila formally ceded their island to the United States in 1900, and in 1904 the authority of this country was recognized by the chiefs of Manua; but although these cessions were accepted by the President, they have never been acted upon by Congress. The political relations of the territory have been fixed chiefly by decisions of certain departments of our Government. Thus Samoans are not citizens of the United States, but they owe allegiance to the flag; vessels owned by Samoans are not entitled to registry, but are nevertheless entitled to fly the flag; while goods imported from the United States pay the same customs duties as those from foreign countries.

Pago Pago, the only port of entry, has the best and safest harbor in the South Seas, formed in the crater of an immense volcano, the south side of which is broken away and open to the sea.

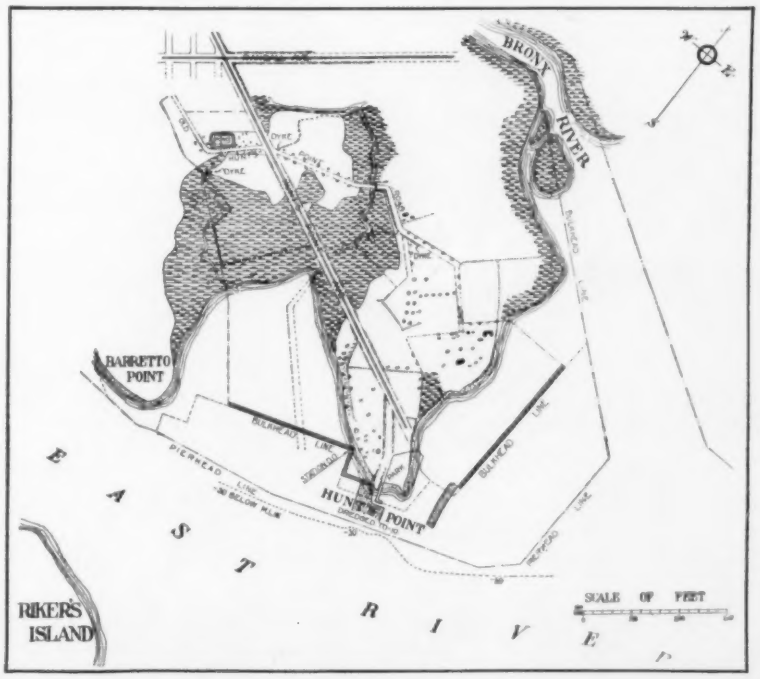
A monthly newspaper, *O le Fa'atonu*, is the government gazette, containing all new regulations and instructions, besides information of general interest.

The leading product and only export of the islands is copra, all of which is marketed for the natives by the government. Blank bids are sent to copra buyers in all parts of the world, the bids received being opened the first of March. The contract is awarded to the highest bidder, if approved by the governor, the contract covering the product of all plantations of Tutuila and Manua for the calendar year. Native taxes are also paid in copra.

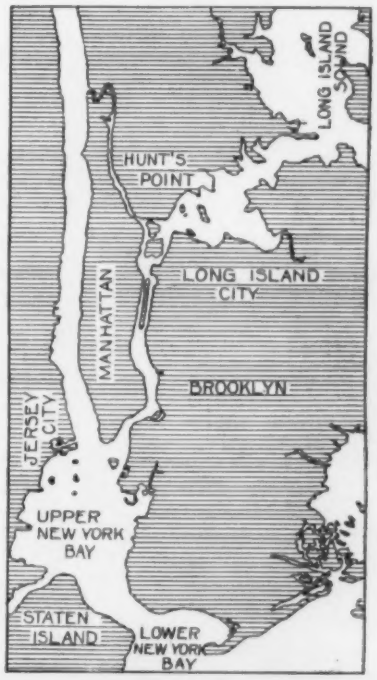
All the natives are Christians and intensely religious. They all go to church, and there are family prayers morning and evening in every Samoan home, while Sunday is scrupulously observed as a day of rest. Practically all the schools in the colony are under the direction of the missionaries, and are conducted by the native pastors of the various denominations. The textbooks are printed in the Samoan language. A number of young Samoans have been sent to Hawaii for higher study, under pledge to return to Samoa and become instructors of their own people.

Although American naval officers hold the principal offices at the seat of government, the provincial and local offices are held by native chiefs. Village chiefs are elected annually. Delegates from all parts of the island are sent annually to a general assembly, the "fono," at which the public affairs of the colony are discussed, though the meeting has no authority to make laws. As to native customs, tattooing is universally practised on men, and frequently on women, despite the efforts of the missionaries and authorities to discourage it. The operation is painful, and the subject is usually laid up for several days following the tattooing, which itself takes three or four days.

The population has decidedly increased under the American *régime*, and was 7,251 in 1912.



Map of the terminal site, showing the positions of the bulkheads.



Map showing position of the Hunt's Point terminal.

Agriculture in Porto Rico is undergoing important changes, under the direction of the local agricultural experiment station, these changes being in the lines of (1) diversification, and (2) adjustment to changed economic conditions. Much of the capital formerly invested in extensive sugar plantations has now been diverted to fruit growing, which in a dozen years has increased in exports from a few thousand dollars to several million. The experiment station is conducting a survey of the island to determine which sections are best adapted to fruit growing, and experiments for improving the fruit industry in every way are being carried on. Special attention is also given to the growing of the coconut and other tropical nuts and improved varieties of mango.

Morning and Evening Stars for 1915

Annual Progress of the Planets in Their Orbits

By Prof. Frederic R. Honey, Trinity College

THE year 1915 presents to the observer of "morning and evening stars" its own peculiar features of interest in planetary current events. Among the most conspicuous of these is Saturn's favorable position for observation, the planet reaching perihelion on February 21st. Jupiter's approach to perihelion steadily increases his brilliancy; while Mars, the war god, draws constantly nearer to us until he reaches his maximum proximity early in 1916.

The Sun.

The Sun is a star of enormous magnitude as compared with the planets whose motions it controls. Its diameter (864,367 miles) is more than 109 times the Earth's diameter and 1,300,000 times its volume. Its axis, which is directed to a point in the heavens midway between Vega and Polaris, is inclined at an angle of 82.75 degrees to the plane of the Ecliptic; i. e., the angle of inclination of the Equator is 7.25 degrees. The Sun's rotation in 25¼ days is proved by the periodic appearance and disappearance of Sun spots, which, in the months of June and December, when the Earth is in the plane of the Sun's Equator, appear to move in straight paths. In March and September their apparent motions are in curved paths. On account of the Earth's movement in its orbit in the same direction as the Sun's rotation—shown by the arrows *A* in the accompanying plots—the Sun *appears* to rotate in 27¼ days, the synodic period.

The Planets.

The volumes of the planets are very unevenly distributed, Jupiter and Saturn absorbing nearly 94 per cent, and Uranus and Neptune together about 6 per cent of the whole, leaving a fraction of 1 per cent for the Terrestrial Planets. In plots of these dimensions the projection of an orbit on the plane of the Ecliptic practically represents its true form. The table gives the mean distance from each planet to the Sun in terms of the Earth's mean distance (=92,894,767 miles); its period in years; its velocity in miles per second; the eccentricity of the orbit; and the inclination of the orbit to the plane of the Ecliptic. The intersection of the plane of a planet's orbit passing through the Sun is the line of nodes. It is shown in Mercury's orbit, but in order to avoid confusion only a small part of it is represented in each of the orbits of the other planets. This page may be regarded as the plane of the Ecliptic, and the point *N* where the planet passes from one side of the Ecliptic to the other side, is the ascending node; *N'* is the descending node, and *P* is perihelion or point of nearest approach to the Sun. The positions of the Terrestrial Planets are shown at intervals of four days, and on account of Mercury's very rapid change in velocity, the positions are given at intervals of two days. In the plots of the orbits of the Terrestrial Planets the positions of Uranus and Neptune are indicated at the dates of opposition and conjunction, and those of Jupiter and Saturn at intervals of 45 and 60 days, respectively. In the plot of the orbits of the Major Planets the positions are given for January 2nd and December 28th. A comparison of the orbit of Mars in the plots will show the great difference of the scales of the drawings. Together they exhibit the continuity of the Solar System.

TABLE I.

SOME ELEMENTS OF THE PLANETARY ORBITS.

Planet	Mean Distance	Period Years	Velocity miles per Second	Eccentricity	Inclination to Ecliptic
Mercury	0.387	0.241	23—35	0.206	7.00°
Venus	0.723	0.615	21.9	0.007	3.39
Earth	1.000	1.000	18.5	0.017	.....
Mars	1.524	1.881	15.0	0.093	1.85
Jupiter	5.203	11.862	8.1	0.048	1.31
Saturn	9.539	29.458	6.0	0.056	2.49
Uranus	19.191	84.015	4.2	0.047	0.77
Neptune	30.071	164.788	3.4	0.009	1.78

The Earth.

Our planet is an oblate spheroid whose equatorial diameter is 7,926.68 miles and polar diameter very nearly 7,900 miles. The Earth's axis, which is directed to a point in the heavens about 1¼ degrees from Polaris, is inclined at an angle of 66.55 degrees to the plane of the Ecliptic; i. e., the inclination of the Equator is 23.45 degrees. The Earth rotates in the direction of the arrow shown at the date January 2nd in the plot of the orbits of the Terrestrial Planets. Each day the Earth moves a distance of nearly 1,600,000 miles; this measurement on the orbit subtends at the Sun an angle on the average of a little less than one degree $\left(=\frac{360°}{365.25}\right)$. Since the eccentricity is 1/60 the distance from the Sun to *C*, the center of the orbit (=*c*) is a little over one and a half million miles, i. e., the Earth is more than three million miles nearer the Sun in January than in July.

Mercury.

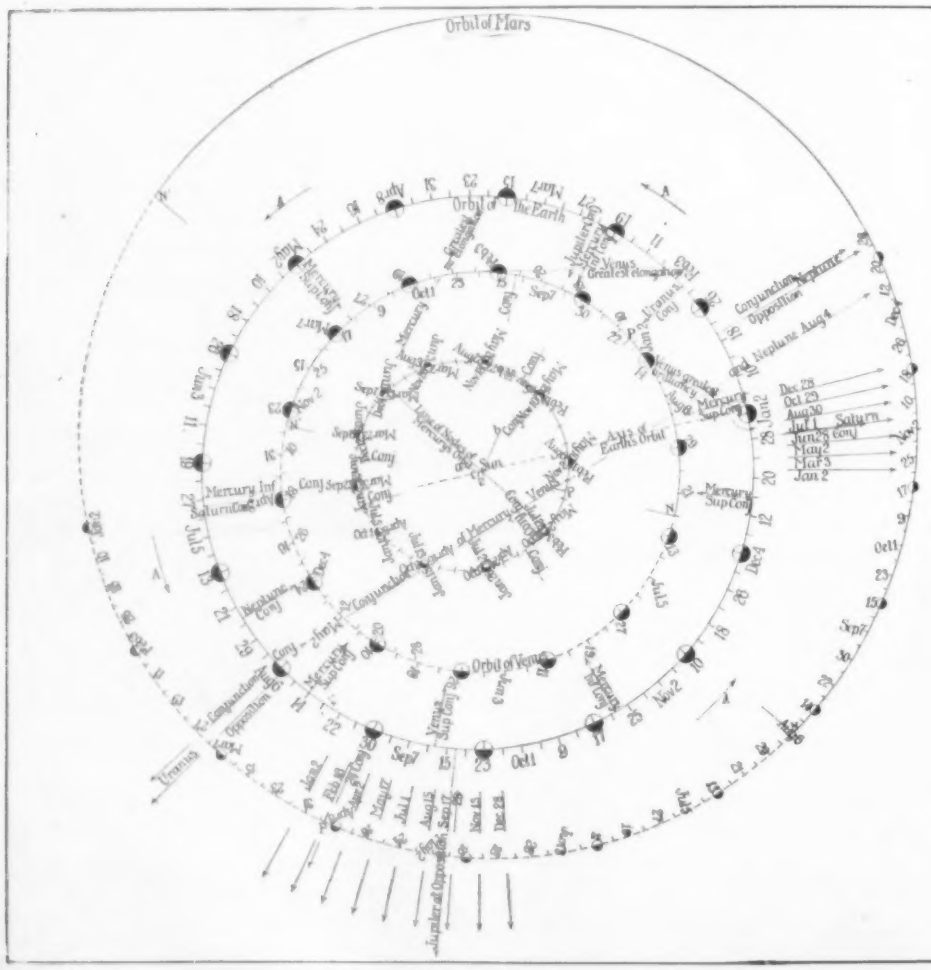
Mercury's diameter is 3,008.5 miles, and the volume is one eighteenth that of the Earth. On account of the great eccentricity of the orbit whose center is at *a*, the planet's velocity varies between 35 miles per second at perihelion and 23 miles at aphelion during its period of nearly eighty-eight days. Since Mercury makes more than four revolutions in the year, four dates are attached to each position. The date of greatest elongation will be March 20th (Fig. 1), when Mercury will be morning star and near aphelion. Other dates of great elongation are February 5th (evening star), May 31st (evening star), July 18th (morning star), September 27th (evening star), and November 6th (morning star). By an inspection of the plot the reader will easily decide upon the dates when Mercury will be seen to best advantage, i. e., when the planet will be farthest from the Sun. Mercury will be nearest the Earth on June 25th (invisible) and farthest from the Earth on December 14th. Fig. 1 illustrates the variations in the apparent diameter of the planet during the year.

Venus.

The diameter of the planet is 7,701 miles and its volume is more than nine tenths the Earth's volume. Owing to the small eccentricity of the orbit, its center can scarcely be distinguished from the Sun in a plot of these dimensions. The period of the planet is 224.7 days, which means that Venus makes more than one and a half revolutions in the year. The dates for the first revolution are affixed without the orbit; those for the second revolution within the orbit. Fig. 2 (January 2nd) shows Venus at the date of greatest brilliancy—the beautiful crescent phase, which occurs five weeks before and after inferior conjunction. February 6th is the date of greatest elongation and September 12th that of superior conjunction. The drawing gives the apparent diameter at the date of conjunction, if the Sun were out of the way.

Mars.

Mars's diameter is 4,549 miles and its volume is one fifth the volume of the Earth. While the eccentricity of Mercury's orbit is greater than that of any of the



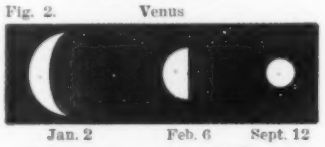
Orbits of the terrestrial planets for 1915.

Fig. 1. Mercury

March 20 June 25 Dec. 14

Variations in the apparent diameter of Mercury.

Fig. 2. Venus



Jan. 2 Feb. 6 Sept. 12

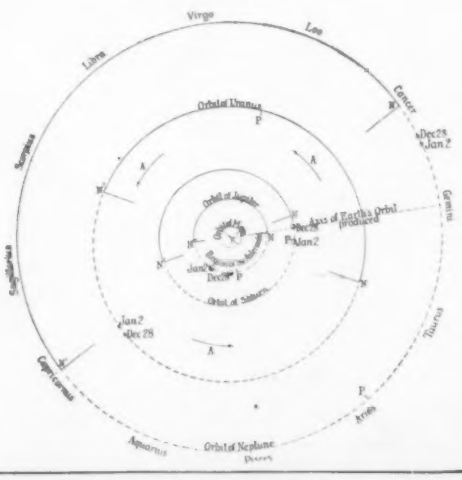
Venus at greatest brilliancy.

Fig. 3. Mars.

Jan. 2 July 1 Dec. 28

Increase in apparent diameter of Mars as it approaches the Earth.

[These three diagrams are drawn to scale.]



Orbits of the major planets for 1915.

Terrestrial Planets, the linear eccentricity or actual distance from the Sun to *b*, the center of the orbit of Mars, is the greatest. Mars will make his perihelion passage on April 5th. The rapid increase in its apparent diameter as the Earth draws nearer to the planet is illustrated in Fig. 3. The next opposition will occur on February 9th, 1916. Figs. 1, 2, and 3 are drawn to the same scale.

Jupiter and Saturn.

Jupiter's equatorial diameter is 90,254 miles and the polar diameter is 84,778 miles, making the volume 1,390 times the Earth's volume. The great brilliancy of the planet is enhanced by approaching perihelion, and Jupiter at opposition (September 17th) will be in excellent position for observation, when the planet's apparent diameter will approach its maximum.

The equatorial diameter of Saturn is 76,455 miles and the polar diameter 69,780 miles. Its volume is 820 times the Earth's volume. Saturn will be at perihelion on February 21st, and thus in excellent position for observation of the rings, at the beginning and the end of the year. The under or southern surface of the rings can now be observed advantageously. The next opposition will occur on January 4th, 1916.

Uranus and Neptune.

The diameters of Uranus and Neptune are, respectively, 30,193 and 34,823 miles, and their volumes are, respectively, 55 and 85 times the volume of the Earth. The linear eccentricity of the orbit of Uranus is the greatest in the Solar System. Its center is nearly 84,000,000 miles from the Sun. The corresponding measurement in the orbit of the more distant planet is less than 24,000,000 miles.

The dates of oppositions and conjunctions are given in Table II, and of conjunctions of the planets in Table III. One illustration of the latter is given in the drawing, viz., three conjunctions of Mercury, Venus, and Neptune, which occur on August 4th.

Morning and Evening Stars.

Morning and evening stars for any assigned date are easily determined by placing the plot of the Terrestrial Planets in a position where the Earth is between the reader and the Sun; thus the dates can be seen without turning the head. A straight edge through the Earth and the Sun will divide the planets into two groups—those on the right, which rise before the Sun and are morning stars; and those on the left, which set after the Sun and are evening stars. Between inferior and superior conjunctions Mercury and Venus are morning stars, and between superior and inferior conjunctions they are evening stars. Before conjunction the other planets are evening stars; after conjunction they are morning stars.

TABLE II—GREENWICH TIME.
CONJUNCTIONS AND OPPOSITIONS.

Date	Conjunction	Opposition
January 5th	Mercury (superior)	
January 19th		Neptune.
February 1st	Uranus	
February 21st	Mercury (inferior)	
February 24th	Jupiter	
May 1st	Mercury (superior)	
June 26th	Mercury (inferior)	
June 28th	Saturn	
July 23rd	Neptune	
August 6th		Uranus.
August 13th	Mercury (superior)	
September 12th	Venus (superior)	
September 17th		Jupiter.
October 22nd	Mercury (inferior)	
December 15th	Mercury (superior)	

TABLE III.
CONJUNCTIONS OF THE PLANETS.

Date	Planets
January 1st	Mercury and Mars.
January 20th	Mercury and Uranus.
February 1st	Mercury and Jupiter.
February 14th	Mars and Uranus.
February 18th	Mercury and Jupiter.
February 28th	Mercury and Mars.
March 18th	Venus and Uranus.
March 23rd	Mars and Jupiter.
March 29th	Mercury and Jupiter.
April 3rd	Mercury and Mars.
April 15th	Venus and Jupiter.
May 14th	Venus and Mars.
May 31st	Mercury and Saturn.
June 24th	Mercury and Saturn.
July 10th	Mercury and Venus.
July 17th	Venus and Saturn.
July 22nd	Mercury and Saturn.
August 4th	Mercury and Venus.
August 4th	MercuryandNeptune.
August 4th	Venus and Neptune.
September 10th	Mars and Saturn.
October 11th	Mars and Neptune.
October 17th	Mercury and Venus.

Extinguishing a Candle

AN ingenious method of extinguishing a candle when it burns down to a certain point is worked as follows: Tie a string around the candle at the desired point, then take the string through the usual loop support or ring at the base of the candlestick, then pass it up to a pair of pulleys on ceiling or wall, bring down the end of the cord just above the candle and tie on a light extinguisher, which thus hangs over the candle. Nails or hooks can be used instead of pulleys for the cord. When the candle burns down to the string, this is detached and lets the extinguisher drop upon the candle. The device should, of course, be tried to make sure that the cord works easily in the different supports.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Directed Fog Signals

To the Editor of the SCIENTIFIC AMERICAN:

The letter from Mr. R. F. Blake in your issue of December 19th recalls an old idea of mine. I have often wondered at its not being used by all vessels having steam whistles. It is, to have a brass megaphone over the whistle so that the sound would go directly forward. Of course the sound would go farther and in a more direct line. When a number of vessels are in a fog, as it is now, the sound waves going out in circles from each whistle, makes it difficult to tell in what direction the vessel is moving. The megaphone, to my mind, would be very inexpensive and of much service in determining the approach of a ship.

FRED. BRADLEE ABBOT.

Bradlee Farm, Sharon, Mass.

Left-hand v. Right-hand Drive

To the Editor of the SCIENTIFIC AMERICAN:

The writer, who has been one of your interested readers and subscribers for a great number of years, was much interested in an article under the heading of "Automobile Notes" in your issue of November 28th, in which you stated that there was noticed recently a tendency to "hog the road" by the drivers of motorcars having a left-hand drive, and it recalled to my mind that this same statement was made to me by a salesman of a car still using right-hand drive at a recent automobile show, so that it is evident that such a notion has been sent broadcast by the sales force of these cars as an argument against the left-hand drive in favor of their continued use of the out-of-date right-hand drive, and it seems odd that you should be misled by such a peculiar argument.

The writer has driven right-hand drive cars for a great number of years and more recently left-hand drive altogether; and since the statement as quoted above was made to him some two months ago, he has made note on the road of the disposition of both right and left-hand drive car operators to find out whether or not there was any basis for such an argument, and after this observation he is convinced that this situation exists solely in the minds of certain salesmen as a selling argument in favor of an acknowledged out-of-date driving position.

I have noticed there is much, if not more, disposition of left-hand drive car operators to give you half or more of the road than right-hand drive car operators, and I feel sure that it is due entirely to the fact that the driver on the left-hand side can judge very much better exactly how much room he is giving the other driver coming toward him because of his much better position on the passing side of his car, and from my driving experience in the last two years with a left-hand drive car I can frankly say that it is the equal in every way of the right drive position on any of the roads that I have encountered in some twenty to twenty-five thousand miles driving during this time.

Dayton, Ohio. C. C. BLACKMORE.

The Mississippi River Problem

To the Editor of the SCIENTIFIC AMERICAN:

Capt. Beauregard Roberts, a man of much experience on our local rivers, said to me the other day that he believed the way to handle the Mississippi River problem was to pump the sand bars out of the river with centrifugal pumps. He said that the sand picked up by the current from eroding banks was carried to the next eddy and deposited, eventually forming a sandbar. The sandbar deflected the current, making the river narrower and causing a faster current. The current at Mobile was slower since the dredging out of the river in front of the city, he said, and while in former years at times of flood they experienced much trouble in towing, now they had no trouble whatever. Logs in rafts would sometimes stand on end, showing in this manner the peculiar character of the current caused by the uneven character of the bottom of the river. It seems to me that Capt. Roberts is correct in his view. Inasmuch as the current of the Mississippi as confined by the levee system does not scour out the river in its bed and take the mud out into the Gulf below New Orleans, but the silt and alluvial soil from above form bars along its course and raise the bed, the constantly increasing deposits must be removed by artificial means, unless the levee system is abandoned and the river left to flood and deposit its silt on the banks.

As it is improbable that the levee system will be abandoned at its present stage, it seems to me that it would be a wise idea to use the released centrifugal dredges recently used in dredging the Panama Canal on the Mississippi River, working up from New Orleans, and gradually removing the sandbars and causing a uniform flow of the water across the whole bed of the river, relieving rapidly the pressure from the flooding above. The sand pumped out of the river could be massed along the front or back of the levees, making an impenetrable rampart to withstand the pressure of the water in the river when it reached the levees. The removal of the sandbars at the same time would prevent, to a large measure, the deflecting of the current against the banks and save them from caving. The bends themselves, which in some measure are responsible for the deflection of the currents, could eventually be removed, the centrifugal dredge eating through the soft soil rapidly, making a small canal, and the water doing the rest. The sandbars, no doubt, are responsible to a large measure for these bends, the current going around them and the bars constantly building out. The deflection of a current by any means to one side of the river will cause the bank to cave on that side and cause an eddy on the other, the silt in the eddy being deposited and forming a sandbar. As the building of a levee by a centrifugal dredge certainly would be far less expensive than the mule shovel system, the river being dredged out at the same time, it seems to me that the levee boards along the Mississippi River would be glad to aid the Government in paying the expenses of operating the dredges.

Mobile, Ala. GEORGE B. CLEVELAND, JR.

Light from Electricians' Black Tape

To the Editor of the SCIENTIFIC AMERICAN:

Unfamiliar facts about very familiar things are constantly being discovered. In the writer's experience, a case of this kind which seems to have heretofore escaped observation, or at least publication, is that of the light sometimes emitted from ordinary electricians' black tape or tire tape. If the tape be quickly stripped from the roll, a line of green light will be noticed at the point where the tape leaves the roll. This light is of sufficient intensity to be seen when the eyes are accustomed to mild diffused daylight. If the tape be rolled up again very tightly and allowed to remain thus for some time a less intense light may sometimes be observed on again stripping off the tape, though this second development of light cannot be depended upon. Surgeon's adhesive tape acts similarly, though the light is not so bright.

The cause of the phenomenon is as yet unknown; static electricity, chemiluminescence and triboluminescence have all been suggested, the last appearing to be somewhat the more probable.

Pittsburgh, Pa. F. ALEX. MCDERMOTT.

Loss of the "Bulwark"

To the Editor of the SCIENTIFIC AMERICAN:

Your article of December 12th, 1914, on the loss of the pre-dreadnought "Bulwark":

This ship had four 18-inch torpedo tubes. Is it not more likely that some fumbling with the war-head of a torpedo blew her up, rather than an accident with the ordinary ammunition? M. I. MECH. E

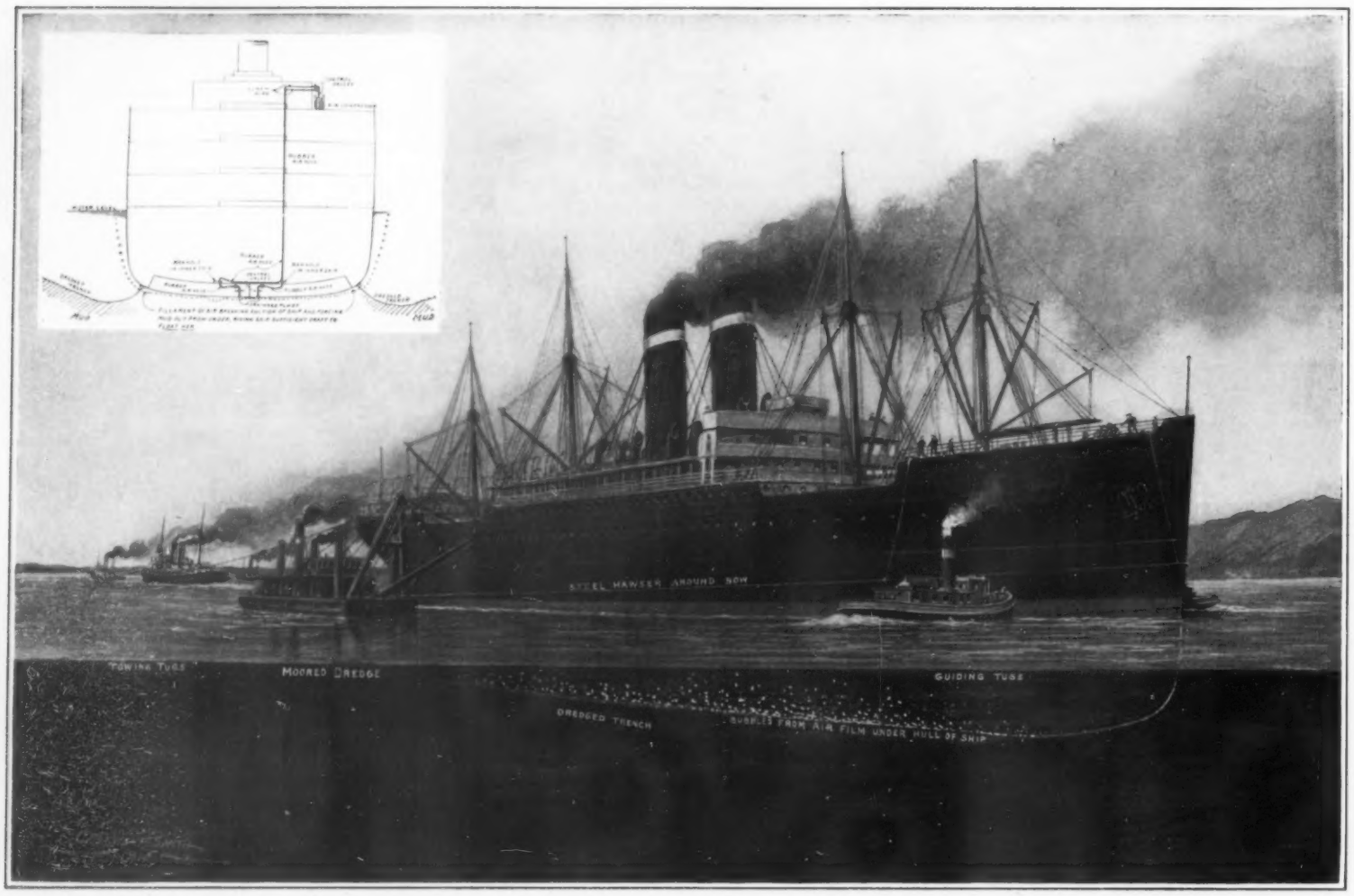
London, England.

A Safety Code for Abrasive Wheels

KNOWING that the majority of the accidents that occur in the use of grinding machines are the result of ignorance of some of the factors essential to safety, and that this lack of appreciation and understanding of proper conditions extends to insurance engineers, State factory inspectors, and officials of labor departments, the abrasive wheel manufacturers appointed a committee to draw up a code for the safe use and care of abrasive wheels and the parts of grinding machines relating thereto. This code had in view not only the supplying to users of grinding machinery and abrasive wheels with complete information and instructions for the safe operation of this class of tools, and to prevent unsafe practices in the future, but is intended to be used as the basis for a campaign for uniform State laws and uniform insurance rules.

This code covers every detail relating to the operating of grinding machinery, including specifications of the proper sizes of wheels and spindles to be used, proper running speeds, sizes and kinds of fittings, and the correct manner of fitting wheels, protection hoods, testing wheels, and all technical details necessary for their safe operation. It is hardly necessary to add that a carefully prepared code of instructions, prepared by competent experts, such as this, is of economical value to all users of this class of machines, as it enables them to secure increased efficiency and avoid delays.

The code prepared by the committee above referred to has been subscribed to and adopted by almost every manufacturer of abrasive wheels in this country and Canada, and it has also been approved by the National Machine Tool Builders' Association.



When the "Zeeland" went ashore during a fog she ran into the mud nearly three feet above her usual light load line. A channel was dredged, but the mud beneath her could not be reached. The salvors loosened the ship by forcing compressed air beneath the bottom.

Floating a Stranded Ship on Air

Refloating the Steamship "Zeeland"

By Robert G. Skerrett

THE famous prophecies of Mother Shipton included, among other things, that the day would come when ships would float upon air, and she probably foresaw the giant Zeppelins. Recently, however, a liner of more than 11,000 tons has been supported by a mere film of air! In fact, this old English prophetess has thus been many times outdone.

On Friday, the 13th of November last, the steamship "Zeeland," bound up the St. Lawrence for Montreal, went ashore during a fog. She was running so fast that she forced herself upon the mud nearly three feet above her usual light load line. The liner was trying to make haste to take on cargo and be off for England with the least possible delay. As navigation generally closes somewhere about the 22nd of November in those waters, the ship had but little time to spare. The question was how to get her off the mud and back into the channel expeditiously. The thing immediately needful was to dredge a channel for her, and this was done, including removing the mud from both sides of her. This left the vessel, however, supported upon a mound beneath her that could not be removed by the dredges, nor could a fleet of tugs and the "Zeeland's" own engines, of more than 12,000 horse-power, dislodge the stranded liner. The grip or suction of the mud was too tenacious.

The salvors hit upon what they thought was a happy expedient. They advised cutting the rivets of a number of plates in the ship's bottom so as to let these go, and then to charge the double bottom space and certain of the neighboring compartments with compressed air, the air to leak out through the holes so made, and, in working its way surfaceward, to break the seal between the craft's skin and the adhering mud. This probably would have done well enough, but it would have obliged the ship to go into drydock and to have the plates replaced—work that would have taken a day or two and at a time when every hour counted.

Mr. W. W. Wotherspoon, representing the Yankee Salvage Company of New York city, was called into consultation and proposed a novel substitute, to which the contract salvors and the underwriters agreed. Mr. Wotherspoon sent his men down into the double bottom of the "Zeeland," where they tapped two holes in the inner ends of fourteen brass drainage plugs already in the liner's bottom plating, which had been placed there from the outside when the ship was built. Key wrenches were fitted into these newly drilled holes and the drainage plugs released by unscrewing them outward and allowing them to sink into the mud.

Immediately afterward, threaded pipe connections were screwed into the holes and rubber hose attached thereto. This hose was then joined up to mains leading from a wrecking air compressor which was installed for the purpose. This air compressor had a capacity of 1,000 cubic feet of free air per minute, and the fourteen holes were widely distributed along the ship's underbody.

This done, a stout wire hawser was looped around the bow of the liner, and each end led to a securely moored dredge, where it was passed around the drums of powerful winches. Lines were led to five tandem teams of tugs, representing a total horse-power of 14,000. Besides this, the ship's boats were put overboard to lighten her, some other weights removed for the same purpose, and nearly 1,700 tons of water ballast drained from her bottom tanks. The ship's engines were alternately worked forward and backward at full power, helping to shake the craft violently. Then the compressed air was blown through the bottom outlets, the seal with the mud was thus broken, and inside of ten minutes from the starting of the tugs and the dredges, which previously had been unable to dislodge the "Zeeland," the liner floated and was promptly towed off into deep water. Under her own steam she sailed at once for Montreal, where she was loaded, and a little later left for England before ice interfered. Screw plugs, inserted from within the ship, replaced the original drainage plugs when the compressed air connections were withdrawn. The substitution was a simple matter quickly effected.

Mr. Wotherspoon had an earlier example for his inspiration, but his employment of compressed air was novel. When the old battleship "Maine" was ready for refloating from the bed of Havana harbor, water jets were used around outside of her at the mud line and through holes drilled in the bottom of the hull. In this fashion the seal between the ship's plating and the mud was broken, and when the cofferdam space was ultimately filled the "Maine" floated easily away from her long resting place. The searching and buoyant character of compressed air made Mr. Wotherspoon's method a more certain one, and the rising streams of bubbles spread out and actually provided a supporting film for the big liner.

The Current Supplement

IN the issue of the SCIENTIFIC AMERICAN SUPPLEMENT for January 23rd, No. 2038, there is an interesting abstract of a lecture delivered by Sir Ronald Ross at Charing Cross Hospital on Malaria and the Transmission of Disease that gives an outline of the history of the theories and the part played by parasites. There is also an account of various investigations by the author that verify modern theories. Applied Electric Science in 1914, by Prof. A. E. Kennelly, of Harvard University, gives a comprehensive survey of the year in this field. An article on the Great Toothed Divers of America, by Dr. R. W. Shufeldt, discusses a remarkable class of prehistoric birds, with illustrations. Our Berlin correspondent sends a timely account of a lecture by a celebrated German surgeon giving his experience on the battlefield during the present war, with comments and explanations of various injuries. A Great Railway Electrification Project tells of plans that are being carried out that will have a decided influence on the future application of electricity for hauling trains, for it includes the handling of both passenger and freight traffic through some of the heaviest sections of our Western mountain country. Excellent illustrations accompany the article. Arithmetical Machines covers the history of these devices, which are much older than most people suppose, and the fundamental theories and principles are set forth clearly and practically. The valuable treatise on Suction Between Passing Ships, that began in the first issue of this year, is completed in the present number with a valuable summary of cases. An article on Fluorescence of Petroleum Distillates sets forth various theories on the subject, and tells of a number of experiments.

A Submarine for the Austro-Hungarian Navy

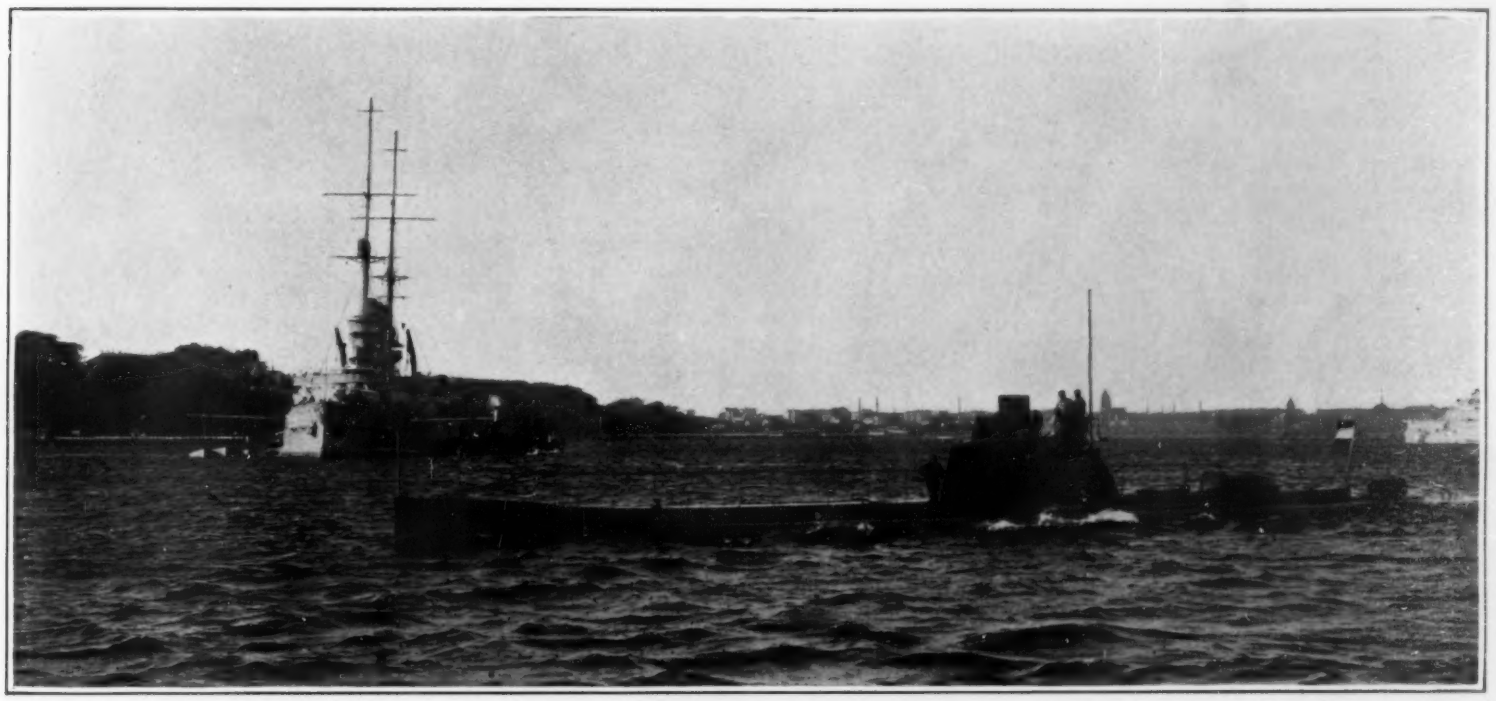
The Latest Krupp Design in Underwater Terrors

By Frederick C. Coleman

THE latest additions to the submersible craft of the Austro-Hungarian navy are represented in the two boats, "U-3" and "U-4," built at the Germania yard, Kiel, of Messrs. Fried. Krupp, Ltd. These boats, illustrated in the accompanying two photographs, have an extreme length of 142 feet, a breadth of 12 feet 4 inches, and a draught (surface) of 9 feet 8 inches. They have an under-water displacement of 300 tons and a surface displacement of 235 tons. The vessels have a double hull, the inside hull being a cigar-shaped watertight body having a structural strength calculated to resist the hydraulic pressure corresponding to a depth of 165 feet. This inner hull is shown, and a view of the first of these two boats taken shortly after launching is also given. The watertight hull is formed of nine circular welded sections, three of which, amidships, are cylindrical, the others, fore and aft, being conical. The hull is subdivided, by means of bulkheads, into several watertight compartments. The bow section contains the torpedo armament and accessories; the next section is occupied by the crew and store room for electrical batteries, and contains also a galley, with electrical cooking range, and lavatory accommodation. The inner ballast tanks are situated amidships, and just below the conning tower is placed the steering gear for the two pairs of diving rudders. The engine room contains internal combustion machinery and electric motors, while the last watertight compartment aft is reserved for another battery of accumulators.

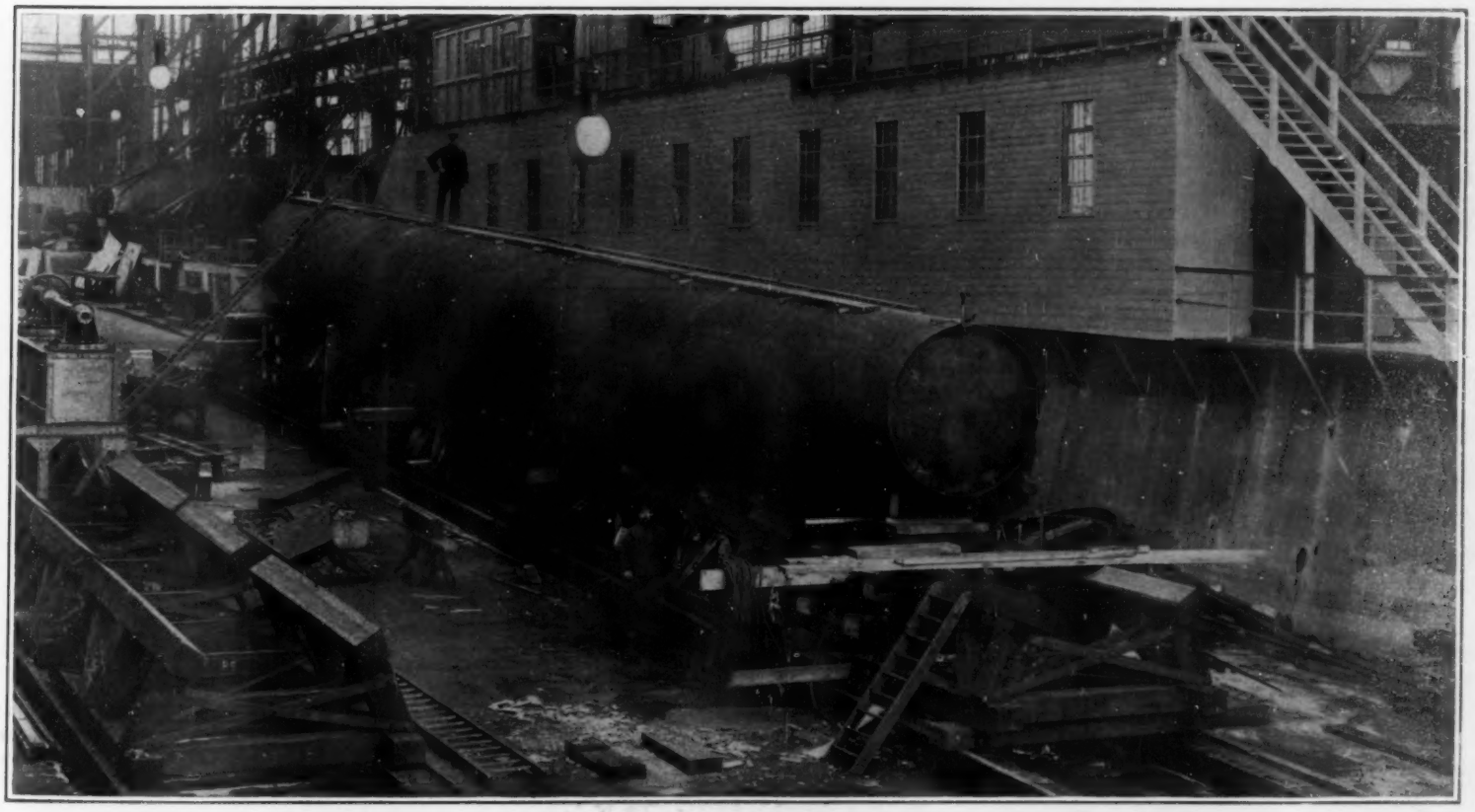
The outside hull does not differ much in shape from that of an ordinary torpedo boat, and is so designed in order to give the boat good sea-going qualities. A weather deck extends throughout almost the whole length of the ship and can accommodate the crew when the boat is traveling on the surface. Between the deck platform and the inside hull the kerosene and most of the water-ballast pipes are fitted. The conning tower, situated amidships, is framed of strong nickel-steel plates capable of resisting the attack of small guns. It is fitted with two periscopes and all the appliances necessary to control the ship in action. The only opening which gives access to the vessel is placed immediately above the conning tower. Communication between the conning turret and the steering gear below is effected

(Concluded on page 89.)



Length, 142 feet. Breadth, 12 feet 4 inches. Draught, at Surface, 9 feet 8 inches. Displacement: Surface, 235 tons; submerged, 300 tons. Speed: Surface, 12 knots; submerged, 8.6 knots.

One of two German-built submarines for the Austrian navy.



This hull consists of nine circular welded sections. Upon this is built the lighter outside hull of surface torpedo-boat form.

The inner cylindrical section of the latest submarines for the Austrian navy.

Fig. 1.—Weighing out the formin.

Fig. 2.—Melting the formin and carbolic acid.

Fig. 3.—Filling the molds.

Synthetic Resins

Non-inflammable Substitutes for Celluloid and Rubber

NEW synthetic resins have been discovered recently and are appearing on the market under many trade names. The resins are used in the production of materials such as artificial amber, pipe-stems, tooth-brush handles, beads, transparent jewelry, buttons of all sizes, inlaid work, knife handles, fountain pens, etc., and take the place of bone, horn, ivory, celluloid, amber, casein (galilolith), ebony, and hard rubber.

These artificial resins in their final conditions do not melt or even soften appreciably at all temperatures, and do not burn like rubber or celluloid. When heated in the air to temperatures well above 500 deg. Fahr. the resins char and burn slowly without a flame. They are quite insoluble in all ordinary solvents, such as gasoline, alcohol, ammonia, washing soda, and acids.

Recent discoveries made in the Industrial Department of Kansas State University have produced radical departures, both in the synthetic resins themselves and the method of producing the same. These discoveries have revolutionized the method of producing synthetic resins and indeed very great changes and differences are brought about in the resins themselves.

By the old or wet process, the resins are produced very simply by boiling together carbolic acid and formaldehyde in the presence of a third substance, a condensing agent, which serves to hasten the formation of the resins. When formaldehyde and a condensing agent are used the resins are produced in the presence of water and the resins must be separated from the layer of water, washed free of the condensing agent and dried. They are then further heated or molded in whatever way is desirable and the final hard resin is produced by heating, generally under pressure, at temperatures upward of 175 deg. Cent.

By the new dry or anhydrous process, phenol, i. e., carbolic acid, is heated together, in a dry condition, with formin. No water is present during the formation of the resins and no condensing agent is needed, which at times is so troublesome and which must later be removed from the resin by careful washing.

This dry reaction in one simple operation produces the resins, which are at first beautiful golden yellow colored liquids, which are entirely free from any substance such as water or condensing agent which must be removed at considerable expense when the resins are produced by the old or wet process. And these dry liquid resins pass under suitable treatment into solid masses which present very closely the appearance of genuine amber.

Formin, the material used to convert the phenol in its dry condition into the anhydrous resin, is a white transparent substance, of sweetish hot taste, in appearance like table salt and having the odor of salt fish; it is known to the organic chemist under the formidable name of hexamethylenetetramine.

The operator in Fig. 1 is shown weighing out the white salt-like formin. The weighed materials are transferred into a flask shown at Fig. 2, fitted with an air condenser of glass, and are heated carefully. The carbolic acid and formin soon melt to a golden liquid, and after sufficient boiling the liquid is poured, while still quite hot, into molds, Fig. 3, of any desired shape and the filled molds are transferred to an open oven without pressure, where they are further heated for the final hardening. This method of forming the resins has the very great advantage that there is no water or condensing agent from which the resins must be separated and dried. A further great advantage consists in being able to produce these resins rapidly without the use of the counter pressure which is so desirable or even necessary when the volatile formaldehyde is used.

After the liquid resin has been heated in the molds for twenty-four hours, it has solidified and has set into the exact shape of the mold. It is then removed from the molds and returned to the oven for further heating. The resin, as it first comes from the mold, is quite soft and can be bent or twisted into any shape very easily and sets permanently in whatever shape it is held for the final heating. The operator, in Fig. 4, is shown bending between his fingers two soft plastic pipe-stems, which have just been removed from the molds. The soft pieces are replaced in the oven, and heated at a very low temperature for several days; at the end of this heating a beautiful transparent yellow material is produced which is harder than silver, gold, or nickel, marble or ivory. Its tensile strength varies from 5,000 to 6,200 pounds per square inch and even higher. It is very interesting and novel to one unacquainted with the great strength of the material to see three tons of iron suspended from a rod of the resin one inch in diameter. The luster is higher than that of amber or any of the natural resins, and its refractive index (1.645) is greater than that of crown glass.

Fig. 4.—Bending pipe bits while gelatinous.

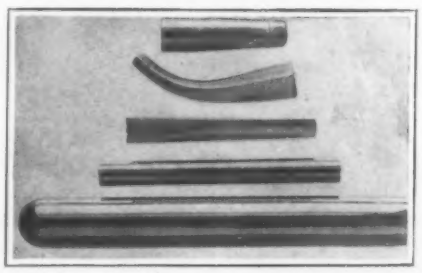


Fig. 5.—Transparent rods and pipe-stems.

Fig. 6.—Polishing the resins.

The transparent goods are remarkably permanent as regards color. Indeed, one of the great advantages possessed by the dry anhydrous resins over those produced by the wet process is their inertness to color changes caused by direct sunlight. The dry resins do not redden rapidly when exposed to direct sun rays.

After the resin has received its final hardening it is shaped and polished on flat horizontal wheels, with fine emery, carborundum, or tripoli. The final polishing is done with oiled buffing wheels. If the molding has been done with sufficient care, the grinding and polishing is quite unnecessary except where a perfect surface and a very high gloss is desired.

These resins can be produced at a cost which can compete for cheapness with the natural resins, such as amber, or with jet, hard rubber, etc. They may be dyed any color, from a pale yellow or ruby red, to a transparent black of great depth and brilliance. When made into jewelry, such as beads, their high refractive index gives a brilliance and transparency surpassing the finest amber.

The resins are also used as binders or glues, and since they are insoluble and do not melt they are of the greatest value as a glue for making hot-water pump valves, valve disks which withstand 650 deg. Fahr. in dry steam, steam pipe gaskets and valves for acid pumps, and pump packing of all kinds. Lists of articles which may be made from these resins when properly combined with suitable fillers are indeed legion. Light pulleys, very uniform in weight, artificial board from sawdust and wood fiber, frictionless bearings for use in machinery for cotton, wool, and silk industries where the machinery cannot be oiled or for bearings under water, ebonite and compoboard, switchboards, heat and electric insulating handles, and heat and electric insulating parts of every conceivable kind are produced at prices which compete readily with the less satisfactory articles which have been on the market up to the present time. Very beautiful transparent and opaque handles are being produced for chafing dishes, coffee percolators, samovars, etc., where strength and beauty must be combined with good heat insulating qualities.

Paints, varnishes, and lacquers are also produced from these resins by dissolving in suitable solvents such as alcohol, acetone, and banana oil, the resins when they are in the initial or soluble state. These coatings, after heating, are almost indestructible by fumes, acids, solvents, salts, or chemicals which easily corrode metals. Brassware, such as beds, urns, candelabra, chandeliers and auto lamps, when lacquered with the resin do not tarnish, as the lacquer film is impervious and indestructible. Varnished surfaces may be left in cold or even boiling water without losing their luster and the paints, when made with the proper fillers, are the best possible protection for metal surfaces exposed to corrosive agencies. The ordinary paints under accelerated electrolytic tests break down in less than twelve hours; coatings made from synthetic resins are unaffected in any way in one hundred hours.

These varnishes and lacquers make the best possible impregnating liquids for electric purposes. The dry films have a dielectric strength of 105,000 volts per millimeter and a resistance of 28 by 10^{9} megohms per cubic centimeter. Paper cartons coated with the varnishes become impervious not only to liquid fats and oils, but also to kerosene and gasoline.

Curiosities of Bygone Ages

Relics from New Mexico and from Bible Lands

Relics of an Ancient People in New Mexico.

BY E. P. WILSON.

AZTEC, New Mexico, is located in the northwest corner of the State and in the midst of the ruins of a prehistoric race that at one time was thickly scattered throughout the region. Irrigated farms now line the valley of the Rio de Las Animas River, where once the roughly built stone dwellings of the ancient people stood. No writings of any kind remain to tell who the builders of these pueblos were or where they went. The Navajo Indian occupied the region when the first white men entered this mountain recess over thirty years ago. The Navajo traditions are unreliable as to the vanished race. One of these is that the Navajo chased the ancient people into the river and they all were turned into fish.

Relics dug from ancient ruins near Aztec, New Mexico.

In excavating one of these ancient dwellings that might have been inhabited as late as 1,500 years ago, Mrs. Orren Randall, living on a farm about a mile west of the modern Aztec, uncovered a curiosity that is one of the most interesting of relics. It is an image or idol, formed of the clay like the pottery that is found so plentifully here. The image is perhaps 16 inches high and is perfect with the exception of one missing leg. It was found with its back against the back of a human skeleton. At the side was found a large bowl with handsome decorations as well as several smaller bowls and mugs.

Image of clay discovered in the New Mexico ruins.

Archæologists have viewed the ruins near where this relic was found, and they estimate that it is 1,500 years since the ruins were inhabited. Arrow points, bone needles, stone ax heads, rocks for grinding grain, corn cobs, bowls of all sizes, mugs, vases, beads, pumpkin rinds and many other things are found by digging into the dilapidated dwellings.

Another Remarkable Discovery in Babylonia.

BY EDGAR J. BANKS.

In the SCIENTIFIC AMERICAN not long since there appeared a translation of a long inscription upon a large clay cylinder of Nebuchadnezzar, king of Babylonia from 604 to 561 B. C. The cylinder was found in the walls of the temple at Marad, south of Babylon, where Nebuchadnezzar buried it for future generations to read. Near the end of the long inscription is an account of the restoration of the temple at Marad in these words:

"At that time in the temple of Lugal-Maradda, my lord, in Marad, whose foundation no former king had seen since ancient days, I sought and found the ancient foundation stone, and upon the base of Naram-Sin, my ancient ancestor, I fixed its foundation. I wrote an inscription and my name and placed it therein."

No tale in fiction is more marvelous than the tale that the archæologist may now tell. The foundation stone of Naram-Sin, the same inscribed stone which Nebuchadnezzar says "no former king had seen since ancient days" has been discovered. A photograph of the inscription upon it is here reproduced.

Who was Naram-Sin, this ancient ancestor of Nebuchadnezzar? Not long ago, when his name first appeared, he was regarded as one of the mythical characters with which prehistoric times was supposed to be peopled. Some years ago in the North Babylonian ruin Abu Habba, the ancient Sippar of the Bible, there was found an inscribed cylinder of Nabonidus, the last king of Babylonia, 555-538 B. C., and the father of the Biblical Belshazzar. In the inscription Nabonidus says that while restoring the temple of the sun-god, he dug to its foundation and saw the foundation stone of Naram-Sin, the son of Sargon, which no former king had seen for 3,200 years. Scholars were amazed at the statement, and at the long period of time which was mentioned. If Naram-Sin lived 3,200 years before the age of Nabonidus, or before 550 B. C., his date was 3750 B. C. Though he was regarded as a mythical being, inscriptions from both him and his father, Sargon, began to appear. On a clay tablet was the story of the birth of Sargon, very similar to that of the birth of Moses. Finally on a rock in the mountains of Armenia a sculptured figure representing Naram-Sin was discovered. Then in several of the Babylonian ruins large square bricks bearing the names of Sargon and Naram-Sin were found, and now a score or more of inscriptions on gold, stone, and clay have convinced us that Naram-Sin and his father were real beings, and have taught us much of their history.

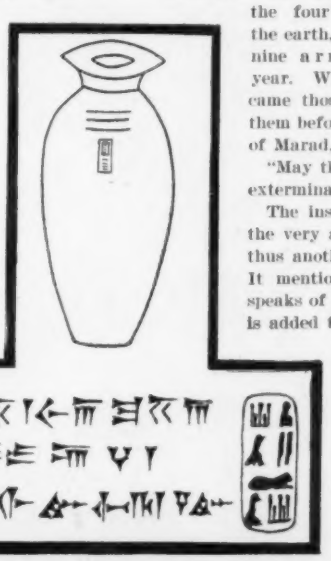
Though Naram-Sin was one of the earliest known kings, it is still to be proved that he lived 3,200 years before Nabonidus, or 3750 B. C. Modern scholars believe that they have evidence that he lived a thousand years later than that date, but undoubtedly, when Nabonidus made the statement, he had before him the long lists of the Babylonian kings, which we know to have existed, and fragments of which have been found. Future discoveries may show that he was correct. Unfortunately Nebuchadnezzar, in his cylinder inscription, does not say how long before his time Naram-Sin lived. We are accustomed to call even the age of Nebuchadnezzar exceedingly ancient, yet it is certain that Naram-Sin lived as long before the time of Nebuchadnezzar as Nebuchadnezzar lived before our time.

The foundation stone of Naram-Sin is in the form commonly called a door-socket. The Babylonians seem to have been unacquainted with hinges for their doors. At one side of the doorway was placed a large flat stone with a cup-shaped hollow in its center. Into the hollow was fitted the wooden door post, which revolved as the door was opened and shut. Similar door posts and door sockets are still to be seen in houses of modern Babylonia. The stone door socket corresponded to our corner stone or foundation stone. It sometimes bore about the hollow, where it might easily be seen, the inscription of the royal builder.

The inscription of Naram-Sin, seen by Nebuchadnezzar and recently found by the Arabs, is on a round yellowish calcite stone about twenty inches in diameter. The uninscribed part of the stone has been cut away. The inscription in its two columns contains thirty-eight short lines. Its characters are of a very archaic form. Its translation reads:

"Naram-Sin, the mighty king of the four quarters of the earth, who subdued nine armies in one year. When he overcame those armies he made their three kings captive, and brought them before the god En-lil. On that day Libit-lil, his son, the governor of Marad, built the temple of Lugal-Maradda in Marad.

"May the gods Shamash and Lugal-Maradda destroy the estate and exterminate the seed of him who alters this inscribed stone."



"Xerxes the Great King" in four languages.

Inscription of Naram-Sin, King of Babylonia, 3750 B. C., which Nebuchadnezzar says that he saw.

Fragments of the vase of Ahazuerus in the New York Public Library.

The inscription is of historical importance. It positively identifies the very ancient Marad with the ruin mounds of Wana-Sadoum, and thus another long lost city may be restored to the map of Babylonia. It mentions a son of Naram-Sin, Libit-lil, hitherto unknown, and speaks of him as the governor of Marad. Another god, Lugal-Maradda, is added to the Babylonian pantheon, and what is no less interesting is that the accuracy of Nebuchadnezzar's statement is established. The very inscription which two thousand years ago he said he saw at the foundation of the temple, and which even then had already lain there for perhaps three thousand years, has been discovered.

A Quadrilingual Inscription From Queen Esther's Husband.

The prize for which the excavator among the buried cities of the ancient civilizations of the Orient is always searching is a bilingual inscription. If one of the two languages of the inscription he hopes to find has not yet been deciphered he thus has a key to a long-lost tongue. With that key he hopes to unlock the secrets of some ancient kingdom and restore to the world history and literature which has long been forgotten. The most familiar of the trilingual inscriptions is the famous Rosetta Stone in the hieroglyphic and demotic languages of ancient Egypt, and in Greek. Arabs discovered it at Rosetta in 1799, and it enabled Champollion to translate the inscriptions on the monuments of ancient Egypt. Another trilingual inscription of equal importance was found among the ruins of the palace of the Persian king, Darius, at Persepolis. Two of its three languages were Persian and Babylonian. By means of it Grotefend deciphered the cuneiform language of Babylonia and restored to the world the vast

(Concluded on page 89.)

Inventions New and Interesting

Simple Patent Law ; Patent Office News ; Notes on Trademarks

Cleaning A City's Water Mains

By J. F. Springer

PEOPLE in general have no realization of the effect of sedimentation and incrustation upon the operation of a city's water system. Indeed, it is probable that, because of the gradual character of the changes, many municipal governments have only a very imperfect knowledge of what is really transpiring. The de-

Fig. 1.—This indicates the pressure and flow of water in a street main that is obstructed by sediment and incrustation.

posits have two effects. First, they cause friction from the irregularity of surface produced. It is reliably stated that nodules projecting no more than $\frac{1}{32}$ or $\frac{1}{16}$ inch may seriously affect the flow of water through pipes, even though they are separated from one another by appreciable distances, and involve only a small fraction of the interior area. It is even said that the variations in smoothness of the interior coating of a new pipe may make a difference in delivery amounting to as much as 25 per cent. An illustration of the retarding effects of irregularities is seen in the necessity of

Fig. 2.—A test of the main shown in Fig. 1 after it had been partially cleaned.

cleaning a ship's bottom fouled with incrustation no thicker than $\frac{1}{4}$ inch. The second effect of deposits consists in the reduction of the effective diameter of the pipe. The combined effects of the two may become very serious. An 8-inch water main in the city of Camden, N. J., had become so obstructed from the accumulations of half a century that, instead of delivering over 1,000,000 gallons of water per twenty-four-hour day, it had a capacity of only 223,000 gallons. Another illustration may be derived from the experience of Belle

Fig. 3.—This shows the pressure made available by fully cleaning the water main.

Plaine, Iowa. Here a cast iron water pipe nearly a mile long and 6 inches in diameter had a capacity when clean of 335 gallons per minute, with a pressure of 60 pounds. This pipe became so clogged that a pressure of 125 pounds was necessary in order to deliver 248 gallons per minute.

Not long ago the city of Hartford, Conn., came to the realization that its system of water mains would soon be inadequate to supply the demand. There are three mains, two of them having a diameter of 20 inches, and one a diameter of 30 inches. There were two methods of meeting conditions, either of which promised success. First, a new supply pipe, 36 inches in diameter and 6¼ miles in length, could be laid at an estimated cost of $270,000. In five years the compound interest at 5 per cent would amount to $74,500. The alternative solution of the problem was to clean the pipes already laid, and thus bring them back to their original capacity. It was estimated that this method of handling the matter would enable the city to defer the laying of a new main for five years. Accordingly, it was a question of the cost of the cleaning. This was found to be only a fraction of the $74,500. Consequently, it was decided to clean out the pipe, and two thirds of the total of nine miles was cleaned.

There are several mechanical methods of cleaning. At Hartford a curious appliance, not unlike some huge caterpillar, was passed through a long length of pipe. This appliance cut away incrustations and scraped away loose material. During the application of this mechanical device a flow of water was maintained in the pipe. In this way the *débris* was flushed out. The whole apparatus was a little less than 9 feet long, and consisted of a number of parts secured to a central shaft, which was jointed or hinged at a number of points. This jointing of the shaft makes the 9-foot apparatus quite flexible, so that corners can be readily rounded. The first part of the cleaner consists of three spiders arranged on the central shaft like vertebræ on the spinal cord. These spiders are provided with sawtooth blades projecting perpendicularly to the shaft, which cut and tear away the incrustation and scale adhering to the pipe wall. Behind these forward spiders are two others, provided with smooth scrapers. The work of the scrapers is less violent than that of the saw teeth, and they clear away material left by the latter. Next are two pistons which fit the pipe wall closely by means of leather gaskets pressed out against the pipe by steel springs. Valves are arranged in the pistons to provide for a regulated passage of water, so that when the apparatus is in operation a stream of water is kept flowing through the pistons, and on ahead of the whole appliance, to wash the loosened material forward, and, in fact, to carry it ultimately out into the open. Back of the pistons are two "vertebræ" which carry other scrapers, arranged in the form of right and left-hand screws, and hardened guide rollers are so arranged as to allow these latter scrapers just to touch the surface of the pipe. On each of the five spiders are arranged three deflecting disks, to throw a current of water out from the center through the cleaning blades and against the walls of the pipe in order to assist in the cleaning and to keep the various scrapers clear.

The methods of getting cleaning apparatus through the pipe are interesting. In accordance with one, the apparatus is dragged through a pipe by means of a rope and winch. Another procedure makes use of the force of the stream of water, but a considerable pressure is necessary. This was the method employed at Hartford, and the machine was carried through by means of the two pistons which provided resisting surfaces to the water current. The valves referred to above allowed the water a restricted opportunity to pass through and ahead and thus maintain a continuous flushing stream. It is estimated that 1,655,000 gallons of water were employed in cleaning 33,093 feet of water main in Hartford, which was about 20 per cent of a day's supply for the city.

The suggestion had been made that the cleaning of cast iron pipe is frequently followed by pitting at a more rapid rate, and it is possible that this may sometimes be the case; but experience has shown that no harm is done to the interior of the pipe by this process.

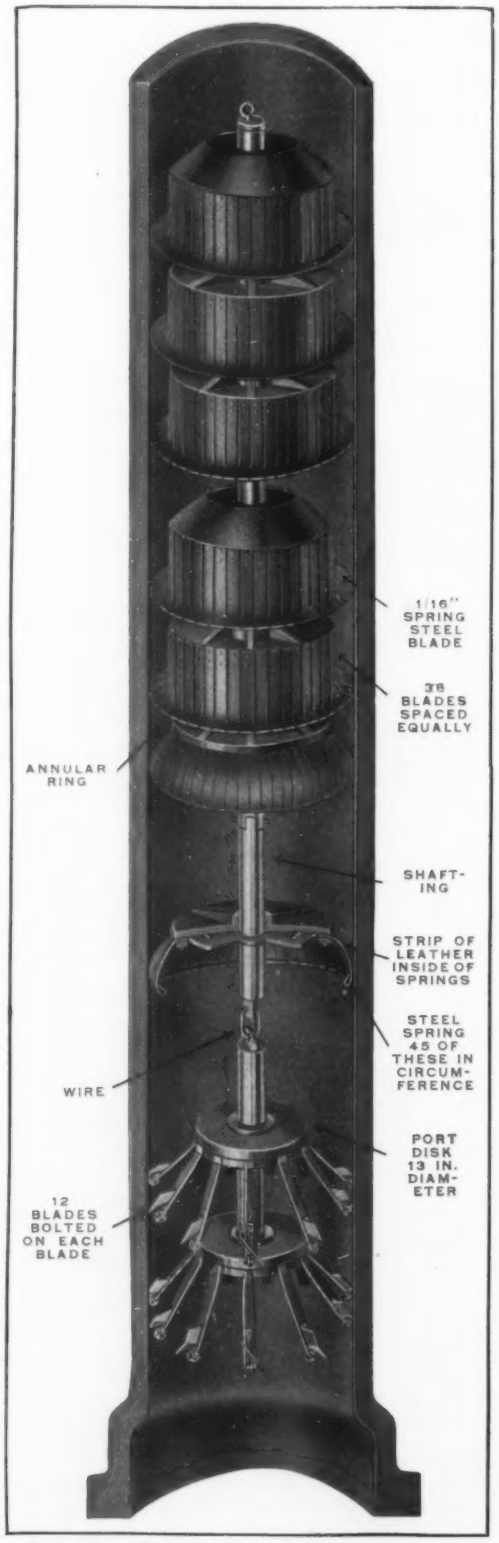
Selling Patent Rights

OFTEN we are asked to recommend some individual or company supposed to be in a position to sell a patent on an invention; but it is impossible to give definite information because no agency exists that can render such a service for patentees generally.

Machinery gives the following advice on the subject:

Selling patents is very different from selling machines or real estate. The range of things covered by patents is almost unlimited, and capitalists, manufacturers, and others interested in promoting inventions for profit are widely distributed in enterprises of every description or attached to none at all. The work calls for innumerable experts. A person qualified to sell patents on shoe machinery would hardly be able to handle machine tool improvements or agricultural implements successfully. The technical side of a patent selling business would alone require encyclopedic knowledge in a person qualified to sell all kinds of patents, and the commercial side would demand a practical acquaintance with commercial conditions in almost every trade.

An inventor with ability enough to work out a practical and valuable invention should be able to apply his powers with equal energy to effecting such relations with others as will result in making his invention profit-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A machine which is passed through a water main to remove incrustation.

able. That such a combination of the inventive and commercial faculty rarely exists is not equivalent to saying that it cannot be developed. It can be; and a man who finds himself in possession of the inventive faculty should carefully study the commercial prospects and conditions and learn how to secure financial cooperation for his ventures. To merely invent is not sufficient; the inventor should be able to produce the children of his brain in shape for others to enjoy.

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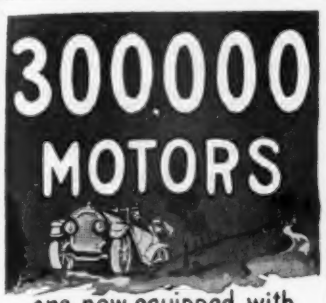

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A Submarine for the Austro-Hungarian Navy

(Concluded from page 85.)

by voice pipes. Aft of the conning tower is a conning platform for surface navigation. The tower is inclosed in a structure, designed on ship-shaped lines, intended to diminish the resistance met when traveling under water. These two submersibles are propelled by two two-cycle heavy oil engines, aggregating 600 horse-power for surface navigation. Two electric motors, designed to develop 320 horse-power, are used for propulsion when the boat is submerged. The motors operate two reversible screws. The engine-room outfit comprises two main and one auxiliary motor-driven bilge pumps, two hand-worked bilge pumps for exhausting bilge and ballast water, air compressors and all accessories. A particular feature of German submarine naval policy is the provision for salving appliances. These, in a way, have preceded the construction of submarine craft. This feature is also emphasized in these boats. They carry a safety keel weighing 5 tons, which can be detached by working a very simple gear, merely by the movement of a handle. By emptying the ballast tanks the boat can be floated in 1½ minutes. Several appliances have been fitted to purify vitiated air, and thus prolong the stay under water, so that the liability to accident is greatly minimized. Air connections are fitted on the outside plating, which, under certain conditions, would allow communication to be made with the atmosphere. A buoy carried on deck can be unfastened from the inside of the hull in order that a telephonic connection can be established with a rescuing crew. Each boat is fitted with two 18-inch Whitehead torpedo tubes and carries a supply of three torpedoes. The surface speed at trials was 12 knots, but it is anticipated that it will be surpassed in deep water trials; the submerged speed is 8.6 knots. At an economic speed of 10 knots the radius of action is given as 1,200 miles above water and 60 miles submerged, the speed in the latter case being 6 knots.

Curiosities of Bygone Ages

(Concluded from page 87.)

literature of ancient Mesopotamian civilization. The language of the mysterious Hittites is still undeciphered, yet several scholars, confident that they have found its key, have published attempted translations, only to find that their labor has been in vain. Men have long been searching for a bilingual inscription, one of whose languages is Hittite, and one such inscription has been found. It is a little silver object about the size of half an orange, now in the British Museum. It bears the words "Tarkendemos King of Ermes" in the cuneiform language of Babylonia, and also some Hittite hieroglyphs which probably mean the same thing, but the hieroglyphs are too few to be of service.

Recently there has been presented to the New York Public Library three fragments of a large onyx base bearing upon its side a quadrilingual inscription. As far as I know this is the only quadrilingual inscription yet discovered. As all of its four languages have been deciphered, it is no longer valuable as a key to a lost tongue, yet it is no less interesting. It sheds new light upon ancient customs, and is evidence of the great intercourse among the nations of the early world.

The onyx vase, when perfect, stood 13 inches high. It had a wide lip, a short neck, and its sides curved gracefully down to its small base. The marks upon the interior walls show that the stone was turned upon a lathe. On the outer wall, just beneath the neck, are three lines of cuneiform writing. The first is in Persian, the second in Elamitic, and the third is in Babylonian. Beneath the three cuneiform lines is a vertical line of writing in Egyptian hieroglyphs. The upper of the hieroglyphs are inclosed in a cartouche, showing that they spell a royal name. The inscription is very short, for in each of the four languages it merely

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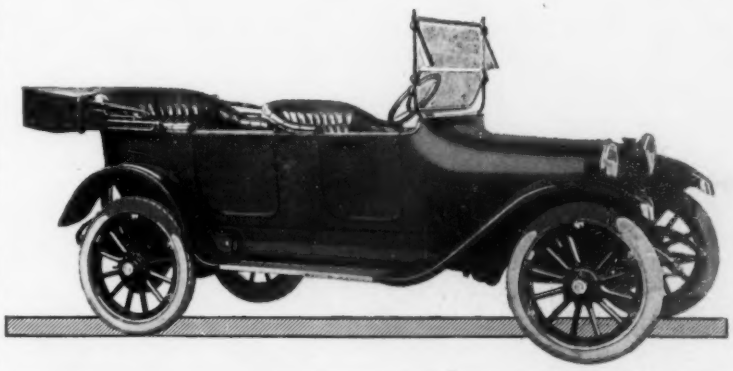

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says: "Xerxes the Great King."

The purpose which the vase served is evident. It was the custom of the ancient Oriental kings and nobles to present votive objects to the temples and shrines; thus they hoped to win the favor of the gods. The most common of such objects were vases of rare stones or of beautiful form. Sometimes the beauty of the stone was the only adornment required; other votive vases were inlaid with ivory and bright stones, or engraved. Most of them were inscribed with the name of the giver. That none might fail to know who was the giver of this beautiful vase, Xerxes had his name inscribed upon it in four languages. To what temple or shrine it was presented is no longer certain, for it was found by wandering Arabs. Evidently, however, it was presented to some prominent religious edifice to which people from the most distant lands resorted, where Persians, Elamites, Babylonians, and Egyptians worshiped.

The name of Xerxes on the vase is of scarcely less interest than the quadrilingual inscription, for Xerxes is no other than Ahazuerus, the husband of Queen Esther of the beautiful Bible story. This story has often been called a fairy tale, and many a scholar has claimed that of all the Persian kings none bore the name of Ahazuerus. Xerxes was the Greek pronunciation of the name, with which we are familiar, but the pronunciation of the name as it was written in Babylonian characters upon the vase is Hi-shi-'i-ar-sh-'a. So the great Assyrian king whom the Greeks called Sardanapalus was known to the Hebrews as Osnapper and to the Assyrians as Assurbanipal. The apparent differences in the ancient names may easily be accounted for by a simple law of phonetics. Ahazuerus and Xerxes are the same, so scholars are now agreed.

In 1852 Mr. Loftus dug a few trenches into the mound containing the ancient royal city of Shush or Susa. It was the same mound in which the French later found the famous stone engraved with the Hammurabi code of laws. There were found the ruins of Shushan, the palace in which Queen Esther lived, and in the palace were numerous inscriptions telling of its history. In 1884 Dieulafoy uncovered the famous banquet hall which figures so prominently in the Book of Esther. Its limestone walls are still standing, and little but its roof, which was supported by thirty-six great columns of stone, has fallen. The walls were highly polished, and the parts which were of stucco were painted red. The floor was paved with bricks. Naturally the interior decorations have perished, but the rugs and draperies of ancient Persia probably surpassed in beauty those of the modern country. In the rear of the hall, beneath a crimson canopy, was the golden throne, and before it were rich carpets which the king's feet alone might tread. There sat the king who received Queen Esther, and who gave as a votive offering to some temple the beautiful onyx vase which is now in the New York Public Library.

Causes of Forest Fires

REPORTS on the forest fires in northern Idaho and Montana state that 35 per cent are caused by railroads, 26 per cent by lightning and 10 per cent by campers, the remainder being due to burning brush and miscellaneous unknown causes. There is one frequent cause of forest fires that is seldom referred to and which has not received proper attention from the authorities, and is those set maliciously and those started by men who expect to earn a few dollars by helping to fight the conflagration they are responsible for. As these latter are usually started near the railroads, these companies generally get the credit for the damage.

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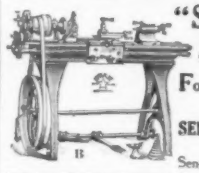

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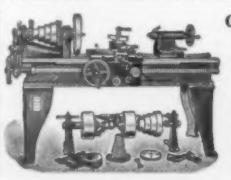

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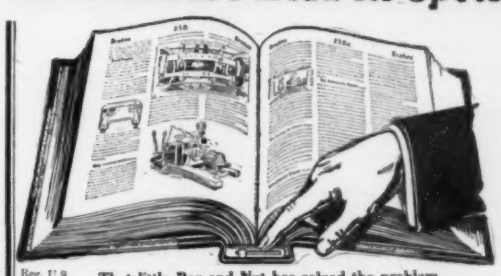

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says: "Xerxes the Great King."

The purpose which the vase served is evident. It was the custom of the ancient Oriental kings and nobles to present votive objects to the temples and shrines: thus they hoped to win the favor of the gods. The most common of such objects were vases of rare stones or of beautiful form. Sometimes the beauty of the stone was the only adornment required; other votive vases were inlaid with ivory and bright stones, or engraved. Most of them were inscribed with the name of the giver. That none might fail to know who was the giver of this beautiful vase, Xerxes had his name inscribed upon it in four languages. To what temple or shrine it was presented is no longer certain, for it was found by wandering Arabs. Evidently, however, it was presented to some prominent religious edifice to which people from the most distant lands resorted, where Persians, Elamites, Babylonians, and Egyptians worshiped.

The name of Xerxes on the vase is of scarcely less interest than the quadrilingual inscription, for Xerxes is no other than Ahazuerus, the husband of Queen Esther of the beautiful Bible story. This story has often been called a fairy tale, and many a scholar has claimed that of all the Persian kings none bore the name of Ahazuerus. Xerxes was the Greek pronunciation of the name, with which we are familiar, but the pronunciation of the name as it was written in Babylonian characters upon the vase is Hi-shi-'i-ar-sh-'a. So the great Assyrian king whom the Greeks called Sardanapalus was known to the Hebrews as Osnapper and to the Assyrians as Assurbanipal. The apparent differences in the ancient names may easily be accounted for by a simple law of phonetics. Ahazuerus and Xerxes are the same, so scholars are now agreed.

In 1852 Mr. Loftus dug a few trenches into the mound containing the ancient royal city of Shush or Susa. It was the same mound in which the French later found the famous stone engraved with the Hammurabi code of laws. There were found the ruins of Shushan, the palace in which Queen Esther lived, and in the palace were numerous inscriptions telling of its history. In 1884 Dieulafoy uncovered the famous banquet hall which figures so prominently in the Book of Esther. Its limestone walls are still standing, and little but its roof, which was supported by thirty-six great columns of stone, has fallen. The walls were highly polished, and the parts which were of stucco were painted red. The floor was paved with bricks. Naturally the interior decorations have perished, but the rugs and draperies of ancient Persia probably surpassed in beauty those of the modern country. In the rear of the hall, beneath a crimson canopy, was the golden throne, and before it were rich carpets which the king's feet alone might tread. There sat the king who received Queen Esther, and who gave as a votive offering to some temple the beautiful onyx vase which is now in the New York Public Library.

Causes of Forest Fires

REPORTS on the forest fires in northern Idaho and Montana state that 35 per cent are caused by railroads, 26 per cent by lightning and 10 per cent by campers, the remainder being due to burning brush and miscellaneous unknown causes. There is one frequent cause of forest fires that is seldom referred to and which has not received proper attention from the authorities, and is those set maliciously and those started by men who expect to earn a few dollars by helping to fight the conflagration they are responsible for. As these latter are usually started near the railroads, these companies generally get the credit for the damage.

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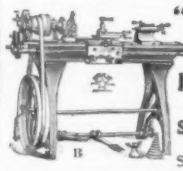

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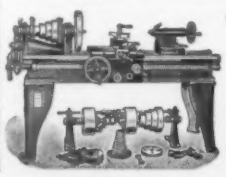

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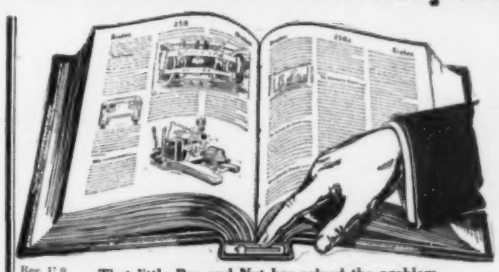

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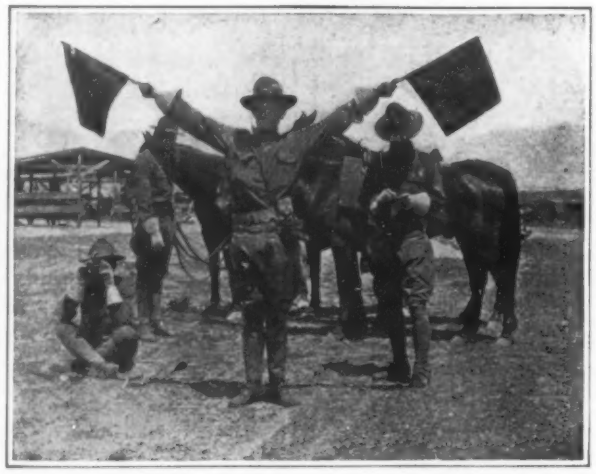

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YOU hear much, these days, of national defense, of our paucity of soldiers and war material. What are the facts? Can we defend ourselves from invasion by a foreign power? How does our Army, how does our Navy compare with the military and naval forces of other powers?

The United States—A Third Class Power

In the next magazine number of the Scientific American, to be published on February 6, 1915, these important questions will be taken up. Do you know that there are not enough regular troops in the United States Army to defend New York City? Do you know that we would have to give up the Pacific coast practically without striking a blow, if we were invaded from that side? Do you know that our State Militia is, on the whole, rather badly organized and inefficient—that it will prove anything but the second line of reserve which European powers can summon in emergency? Do you know that we are a third-class naval power?

These questions vitally concern every American citizen. They will be exhaustively discussed in the February magazine number of the Scientific American. There you will be told impartially how many ships we have and how many we need; you will be told what is our actual military strength and what it ought to be; you will be told how woefully deficient we are in munitions of war.

More Interesting War Articles

Although the subject of national defense will be the most important that will be taken up in the February magazine number, the technical aspects of the present European conflict will also receive popular treatment. To say that there has never been a conflict like this is trite but true. Each day reveals some new artifice, scientific in character, of which the public knows nothing. It is the peculiar province of the Scientific American to describe and illustrate these developments in the art of warfare.

We hear much these days of bomb-dropping, for example. What are the difficulties of bomb-dropping? What are the dangers incurred by the bomb dropper? Mr. Carl Dienstbach's article, "Aircraft, Artillery and Bomb-Dropping," will take up these questions critically.

Detailed Pictures of Machine Guns

There will be detailed drawings of the Maxim machine gun, which is playing such a great part in this war, and also of the Lewis gun, this latter being an American weapon which has found its first application in the present European war.

"The Motorcycle in War" is the title of an article which will reveal the part that a very recent improvement in locomotion is playing in battle.

Besides these articles there will also be many pictures from the front—all of them of both popular and technical interest.

There will also be material of a generally interesting scientific character for those who wish to keep abreast of the scientific times.

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